Consultation Number: F/NWR/2004/00224

Endangered Species Act (ESA) Section 7 Consultation - Supplemental Biological Opinion

Action Agency: National Marine Fisheries Service

Species/ESU's Affected:

Species	ESU	Status	Federal Register Notice	
Steelhead	Lower Columbia River	Threatened	63 FR 13347	3/19/98
(*O. mykiss*)	Upper Willamette River	Threatened	64 FR 14517	3/25/99
	Middle Columbia River	Threatened	64 FR 14517	3/25/99

Activities considered: The proposed increased in allowable incidental take of steelhead Evolutionarily Significant Units (ESUs) affected by the non-Indian commercial spring Chinook fishery in 2005.

Consultation conducted by: The Sustainable Fisheries Division (SFD), Northwest Region. Consultation Number: F/NWR/2004/00224

The U.S. v Oregon parties entered into a 5-year Agreement in 2001 regarding winter, spring, and summer season fisheries (U.S. v Oregon parties 2001), which the National Marine Fisheries Service (NMFS) considered in an associated biological opinion (NMFS 2001). Prior to the 2005 season, the states of Oregon and Washington proposed to modify certain provisions of the fishery management plan that formed the basis of the 2001 agreement among the parties. The states proposed an increased in the allowable incidental take limit for winter-run steelhead populations in three Columbia River ESUs affected by the non-Indian commercial spring Chinook tanglenet fishery in 2005. The states propose to increase the allowable take of listed winter-run steelhead from the current 2%, to a maximum of 6%. The affected steelhead ESUs include Lower Columbia River, Upper Willamette River and Middle Columbia River steelhead ESUs. In this supplemental biological opinion, NMFS evaluates the current proposal. This biological opinion has been prepared in accordance with section 7 of the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 et seq.). A complete administrative record of this consultation is on file with Sustainable Fisheries Division in Seattle, Washington.

Approved by: Joe Scordino for D. Robert Lohn, Regional Administrator

Date: 1/6/05

[Expires on: June 30, 2005 **]**

TABLE OF CONTENTS

Consultation Number: F/NWR/2004/00224

BACKGROUND

The U.S. v Oregon parties entered into an Agreement in 2001 regarding winter, spring, and summer season fisheries (U.S. v Oregon parties 2001). NMFS conducted a Section 7 consultation on the Agreement and associated Biological Assessment and Section 10 permit application submitted by the tribes and states, respectively (Speaks 2000, Tweit and Norman 2000). One of the provisions considered during the consultation was that the combined incidental mortality rate in all non-Indian fisheries would be 2% or less for each of the affected steelhead ESUs. NMFS concluded in its biological opinion that the implementation of the fisheries as proposed would not jeopardize any of the affected ESUs (NMFS 2001). The 2001 Agreement, or portions thereof, remain in effect through 2005, and potentially beyond so long as fisheries are managed consistent with the terms of the Agreement.

In 2002, the states of Oregon and Washington implemented their first full fleet commercial spring Chinook selective tangle net fishery, contemplated in the Agreement. The fishery relied on the use of tangle nets for live capture and required the release of all steelhead and unmarked Chinook. As the fishery progressed, it became apparent that the impacts on steelhead were much greater than anticipated – this was confirmed through post-season analysis, as described below.

The U.S. v. Oregon Technical Advisory Committee (TAC) tangle net fishery report (TAC 2003) provides specific estimates of steelhead mortality rates associated with the 2002 fishery. TAC estimated that the incidental mortality rate on the aggregate of winter-run steelhead during the 2002 fishery, including Upper Willamette steelhead and the winter run populations of the Lower Columbia River and Middle Columbia River ESUs, likely ranged between 5.6% - 14.5% (TAC 2003). Because the incidental take associated with this fishery in 2002 exceeded the take exemptions of the original consultation, and because this fishery was to be conducted in 2003 and beyond, NMFS reinitiated its consultation of the 2001 Agreement in 2003.

The Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW) provided NMFS a list of steps to be taken to modify the management guidelines for the commercial spring Chinook tanglenet fishery (LeFleur 2003). These additional management guidelines were intended to reduce impacts on winter steelhead and ensure that the commercial spring Chinook tanglenet fishery was carried out within the Endangered Species Act (ESA) constraints specified in the 2001 biological opinion (NMFS 2001). These additional management guidelines amended the Agreement by describing in more detail how the non-Indian commercial spring Chinook tanglenet fishery was to be managed (LeFleur 2003). In 2003, NMFS wrote a supplemental biological opinion based on the states' new management guidelines. NMFS concluded in its supplemental biological opinion that modified management provisions would allow fisheries to be managed within the previously defined incidental take limits and reaffirmed that the fisheries were not likely to jeopardize any of the affected ESUs (NMFS 2003).

On January 2, 2004, the WDFW and ODFW submitted a biological assessment of the impacts of the fisheries on the listed species and proposed to modify the provisions of the management plan that formed the basis of the 2001 agreement among the parties, the 2001 biological opinion (NMFS 2001) and the 2003 supplemental biological opinion (NMFS 2003). WDFW and ODFW proposed to authorize impact rates up to 7% for listed steelhead ESUs in 2004 and 2005 (LeFleur and King 2004). The objective of their proposal was to allow better access to harvestable, non-listed spring Chinook.

After the states submitted the 2004 biological assessment, NMFS, in a letter dated January 22, 2004, requested further clarification and information. In response to this request the states prepared a revised biological assessment that included an impact rate of up to 6%, with a management goal of 5%, for 2004 and 2005, which was submitted on February 13, 2004 (LeFleur and King 2004). However, NMFS still had outstanding questions and the 2004 fishery concluded before these outstanding questions were resolved.

After the 2004 fishery concluded, the states formed a work group of WDFW and ODFW staff that included harvest managers, steelhead biologists, and population biologists to deal with outstanding issues. NMFS staff also attended the work group meetings. The work group was formed primarily to respond to questions and issues regarding the management of wild winter steelhead in the Lower Columbia River commercial fishery as proposed under the current consultation. The work group provided two supplemental reports that focused on the question of run timing on February 27, 2004 and March 4, 2004 (WDFW/ODFW 2004 a, WDFW/ODFW 2004 b). On November 2, 2004, the states submitted an additional addendum to the February 13, 2004 biological assessment (LeFleur and Melcher 2004).

The states are proposing an increase in the allowable incidental take limit for listed winter-run steelhead populations in three Columbia River ESUs affected by the non-Indian commercial spring Chinook tanglenet fishery in 2005 from 2% to 6%, with a management guideline of 5% (LeFleur and Melcher 2004). The affected steelhead ESUs include Upper Willamette River, Lower Columbia River and Middle Columbia River steelhead ESUs. The Upper Willamette River ESU includes only winter-run steelhead populations. The Lower Columbia River ESU is comprised primarily of winter-run populations (fourteen of twenty extant populations have winter-run timing). The Middle Columbia River ESU includes two population with winter-run timing. Other steelhead populations in this ESU have later run-timing and are referred as summer-run steelhead. As proposed, the fishery would be managed for a 6% mortality rate limit on the aggregate of returning listed winter-run steelhead. Because of the run timing difference and the structure of the fishery, relative few listed summer-run steelhead are caught during the winter, spring, and summer season fisheries covered by the 2001 Agreement. As proposed, the fishery would also be subject to a 2% harvest-related mortality rate limit for the summer-run component of the Lower Columbia River and Middle Columbia River ESUs. Most of the impacts to these three steelhead ESUs would be associated with the commercial spring Chinook tanglenet fishery, with few additional impacts in the recreational fishery. In this supplemental biological opinion, NMFS evaluates the current proposal for 2005.

The proposed increase in listed winter-run steelhead mortality is for 2005 only. If the state proposes to continue using a higher mortality limit for winter steelhead in 2006 or beyond, they will again have to reinitiate consultation or otherwise propose how they will manage these fisheries in the future. The states have indicated that, prior to the 2006 season, they intend to further consider the status of winter run populations, and investigate options related to the use of a sliding scale mortality rate schedule that would depend on the status of the populations and indicators of marine survival. A risk assessment that relates population abundance to alternate harvest levels or strategies would also be useful for future consultations. In reviewing the proposed action for 2005, NMFS takes the states' statement of intent regarding additional work prior to 2006 as a substantive commitment.

BIOLOGICAL OPINION

1.0 DESCRIPTION OF THE PROPOSED ACTION

1.1 Proposed Action

The action considered in the 2001 biological opinion (NMFS 2001) was for the Federal parties to U.S. vs Oregon to enter into an Interim Management Agreement with the non-Federal parties to the case regarding the management of winter, spring, and summer season fisheries in the Columbia River Basin. The fisheries considered in the 2001 Biological Opinion included winter, spring, and summer season fisheries in the Columbia River Basin as proposed by the Columbia River treaty tribes (the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, and the Confederated Tribes and Bands of the Yakama Indian Nation) (Speaks 2000), and the states of Oregon and Washington (Tweit and Norman 2000).

In this supplemental biological opinion NMFS considers the proposal to modify certain provisions of the original management plan. The states of Oregon and Washington are proposing to allow for an increase in the incidental take of winter steelhead populations belonging to the Upper Willamette River, Lower Columbia River and Middle Columbia River steelhead ESUs from the current 2% specified in the existing biological opinion (NMFS 2001) and supplemental biological opinion (NMFS 2003) according to the states' proposal for 2005 (LeFleur and Melcher 2004). The states propose managing subject to a 6% harvest mortality limit on the aggregate of returning listed winter-run steelhead, with a management guideline of 5% in 2005. The proposed 6% incidental take limit is a cap and not a target. The states propose to manage their fishery to minimize the impacts to steelhead to the degree possible. The actual incidental take is therefore expected to be less than or equal to 6%. The 5% management guideline is one action designed to buffer against the prospect of exceeding the proposed 5% incidental take cap.

A key assumption of the proposal, discussed in more detail later, is that the incidental mortality rate for steelhead associated with the spring Chinook tanglenet fishery is the same for each of the affected steelhead ESUs. Although there are minor impacts to winter steelhead in mainstem recreational fisheries at this time of year, virtually all of the impacts occur in the commercial fishery. Nonetheless, mortality resulting from the recreational fishery is counted against the total mortality rate limit.

The states propose to modify the currently allowed mortality rate on winter populations of the three ESUs, but do not propose to change the current mortality rate limit on summer run populations in the Lower Columbia River and Middle Columbia River ESUs. Summer run populations would continue to be subject to 2% mortality limit. Since the proposal would not change the level of impact for summer run populations considered in the 2001 and 2003 consultations, this opinion focuses on information related to winter steelhead and the effect of the proposed action.

The catch-and-release mortality rate varies for different gear types, different species, and different fishing conditions, and those values are often not well known. Catch-and-release mortality rates have been estimated from available data and applied by the Technical Advisory Committee to *U.S. v Oregon* (TAC) in the calculation of impacts to listed fish evaluated in this consultation. At the February 5, 2004 Compact hearing the states adopted the TAC recommended mortality rates of 18.5% for steelhead captured and released using small mesh nets ($\leq$ 4¼") and 30% for steelhead captured and released using large mesh nets ($\geq$ 8"). No additional long-term mortality studies are in progress at this time, and these same mortality rates will be used again for estimating fishery-related incidental mortality in 2005.

The states have developed a fishing plan for 2005, which includes test fishing prior to every opening of the commercial tanglenet fishery to provide pre-fishery estimates of stock composition of spring Chinook and relative abundance of steelhead in the fishing area. The states will use this information in determining when it is appropriate to set a full fleet fishery and which gear restrictions, primarily mesh size restrictions, should be adopted. Past experience confirms that test fishing is a valuable tool to help determine when the best conditions are in place to maximize harvest of hatchery spring Chinook and minimize handle of steelhead and what is the best gear to accomplish this task.

The states will be looking for a large percentage of Willamette hatchery spring Chinook in the catch and a low percentage of upriver spring Chinook. Information on the number of steelhead handled will be used to make decisions about specific gear configurations for specific open periods. The fishing plan calls for the full fleet fishery to occur within two days of the test fishery, to help assure that the conditions during the actual fleet fishery, in terms of spring Chinook stock composition and steelhead abundance, are comparable to those observed during the test fishery.

The states will require the use of 9 inch mesh size in the first few open periods of the fishery when the relative abundance of Upper Willamette spring Chinook is high to minimize handling of steelhead. Additionally, the use of steelhead excluders for 2005 is being strongly encouraged, but will not be mandatory. The states intend to collect additional information on the effectiveness of these nets and may require their use in future years. Information gathered in 2005 on the steelhead excluder will be added to the data from previous years and tested to see if there is a difference in steelhead catch with or without a steelhead excluder.

<u>Management Guidelines</u>
The management actions and consequent measures for the non-Indian commercial spring Chinook tanglenet fishery included in the 2003 Supplemental Biological Opinion (NMFS 2003) would remain in effect for 2005. In addition, for 2005 the states propose the following six additional management actions and measures:

1 A commercial fishing plan for 2005 will be adopted at the January 28, 2005 Compact hearing. This fishing plan will set forth a schedule for test fishing, decision making dates, and possible commercial fishing dates to ensure that the fishery focuses harvest on hatchery Willamette spring Chinook and minimizes handle of listed spring Chinook and steelhead.

2 Fishing period lengths will not exceed 16 hours.

3 The minimum mesh size restriction for large mesh portion of the fishery is 9". The 9" minimum mesh size regulation should nearly eliminate steelhead handle during this period.

4 Larger sanctuaries around the Washington tributary mouths will be adopted at the January 28, 2005 Compact hearing.

5 The fishery will limit commercial fishing during the 3rd to 4th weeks of March or when wild winter steelhead abundance is at its peak. Fishing during this time frame will be based on results of test fishing or previous commercial fishing periods. This management strategy may require some commercial fishing in April to reduce steelhead handle during late March.

6 The use of steelhead excluders will be encouraged by the states in 2005.

1.2 Action Area
The action area of the 2001 Biological Opinion encompasses the Columbia River and its tributaries from its mouth upstream to the Wanapum Dam, and in the Snake River up to the Washington/Idaho border. However, the spring Chinook tanglenet fishery being considered in

this supplemental biological opinion, occurs in a more limited area in the Columbia River, from its mouth upstream to Bonneville Dam.

2.0 STATUS OF SPECIES UNDER THE ENVIRONMENTAL BASELINE

In order to describe a species' status, it is first necessary to define precisely what "species" means in this context. Traditionally, one thinks of the ESA listing process as pertaining to entire taxonomic species of animals or plants. While this is generally true, the ESA also recognizes that there are times when the listing unit must necessarily be a subset of the species as a whole. In these instances, the ESA allows a "distinct population segment" (DPS) of a species to be listed as threatened or endangered. Lower Columbia River Steelhead, for example, is just such a DPS and, as such, are for all intents and purposes is considered a "species" under the ESA.

NMFS developed the approach for defining salmonid DPSs in 1991 (Waples 1991). It states that a population or group of populations is considered distinct if they are "substantially reproductively isolated from conspecific populations," and if they are considered "an important component of the evolutionary legacy of the species." A distinct population or group of populations is referred to as an evolutionarily significant unit (ESU) of the species. Hence, Lower Columbia Steelhead, for example, constitute an ESU of the species *O. mykiss*.

The discussion in this opinion is limited to the three steelhead ESUs with winter steelhead populations that would be subject to impact rates under the proposed action that would be higher than those currently exempted in the 2001 Biological Opinion. These include Upper Willamette River, Lower Columbia River and Middle Columbia River steelhead ESUs listed as threatened under the ESA (Table 1). The status of these ESUs is described in the 2001 Biological Opinion (NMFS 2001) which is incorporated here by reference. That information is updated and described in more detail in the following discussion, particularly to include abundance information for 2002, 2003, 2004 and estimates for 2005.

Table 1. Steelhead ESUs subject to further review in this Biological Opinion.

Species	Evolutionarily Significant Unit	Present Status	Federal Register Notice	
Steelhead (*O. mykiss*)	Upper Willamette River	Threatened	64 FR 14517	3/25/99
	Lower Columbia River	Threatened	63 FR 13347	3/19/98
	Middle Columbia River	Threatened	64 FR 14517	3/25/99

2.1 Life History and Critical Habitat of Affected Steelhead ESUs

The general life history characteristics of steelhead ESUs are described in the 2001 Biological Opinion (NMFS 2001).

Critical habitat was previously designated for the three affected steelhead ESUs. However, these critical habitat designations were vacated on 09/29/2003 (68 FR 55900) in response to litigation. In absence of a new rule designating critical habitat for these ESUs, this consultation will evaluate the effects of the proposed actions on the essential features of species' habitat to determine whether those actions are likely to jeopardize the species' continued existence. On November 30, 2004, NOAA Fisheries filed proposed rules with the Federal Register to designate critical habitat areas in Washington, Oregon, Idaho and California for the 20 species of salmon and steelhead listed as threatened and endangered under the Endangered Species Act (ESA). The proposal includes a separate rule for 13 species listed in Washington, Oregon and Idaho (69 FR 74572, December 14, 2004). The final rules are scheduled to be completed by NOAA Fisheries by June 2005.

2.2 Status of Affected Steelhead ESUs

To determine a species' status under extant conditions (usually termed "the environmental baseline"), it is necessary to ascertain the degree to which the species' biological requirements are being met at that time and in that action area. For the purposes of this consultation, the biological requirements of the three affected steelhead ESUs are expressed in two ways: Population parameters such as fish numbers, distribution, and trends throughout the action area; and the condition of various essential habitat features such as water quality, stream substrates, and food availability. Clearly, these two types of information are interrelated. That is, the condition of a given habitat has a large impact on the number of fish it can support. Nonetheless, it is useful to organize the description of the species' biological requirements into two sections to provide a more complete picture of all the factors affecting their survival. Therefore, the discussion to follow will be divided into two parts: Species Distribution, Trends and Productivity, and Factors Affecting the Environmental Baseline.

2.2.1 Distribution, Trends and Productivity

2.2.1.1 Upper Willamette River Steelhead ESU

As part of its effort to develop viability criteria for the Upper Willamette River steelhead ESU, the Willamette/Lower Columbia Technical Recovery Team (WLC-TRT) has identified historically demographically independent populations (Myers et al. 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany et al. 2000). Myers et al. (2002) hypothesized that the ESU historically consisted of at least four populations and possibly a fifth (Table 2). There is some uncertainty about the historical existence of a historical population in the west side tributaries. All steelhead in the ESU must pass Willamette Falls, located at River Mile 27 on the Willamette River and at RM 127 from the Columbia River mouth.

An analysis was conducted by Steel and Sheer (2002) to assess the number of stream kilometers (km) historically and currently available to steelhead populations in the Upper Willamette River (Table 2). Stream km usable by salmon are determined based on simple gradient cut offs, and on the presence of impassable barriers. This approach will over estimate the number of usable stream km as it does not take into consideration habitat quality (other than gradient); however, the analysis does indicate that for all populations the number of stream km currently accessible is reduced significantly from the historical condition.

Table 2. Historical populations of Upper Willamette River steelhead and loss of habitat from barriers[1].

	Potential Current Habitat (km)	Potential Historical Habitat (km)	Current to Historical Habitat Ratio (%)
Molalla River	521	827	63
North Santiam River	210	347	61
South Santiam River	581	856	68
Calapooia	203	318	64
West Side Tributaries	1376	2053	67

[1] The potential current habitat is the kilometers of stream below all currently impassible barriers between a gradient of 0.5% and 4%. The potential historical habitat is the kilometers of stream below historically impassible barriers between a gradient and 0.5% and 6%. The current to-historical habitat ratio is the % of the historical habitat that is currently available

Two groups of winter steelhead currently exist in the upper Willamette. The “late-run” winter steel exhibit the historical phenotype adapted to passing the seasonal barrier at Willamette Falls. The falls were laddered and hatchery “early-run” winter steelhead fish were released above the falls. The early-run fish were derived from Columbia Basin steelhead outside the Willamette Basin, and are considered non-native. The release of winter-run hatchery steelhead has recently been discontinued in the Willamette Basin, but some early-run winter steelhead are still returning from whatever natural production of the early-run fish that has been established. Non-native summer run hatchery steelhead are also released into the upper Willamette River.

Genetic analyses indicate a close genetic affinity between winter steelhead populations in the Santiam, Molalla (North Fork), and Calapooia Rivers. Steelhead descended from summer-run (Skamania) and early-run winter (Big Creek) hatchery populations are distinct from the native steelhead, which are the subject of this analysis.

Escapement information is available for all Upper Willamette River steelhead ESU populations, except for West Side tributaries. The recent trend in wild winter steelhead abundance was in decline during the 1990's, followed by increases beginning in 2000 (Table 3 and Figure 1). Information is also available for the ESU as a whole by evaluating passage information over Willamette Falls. The Willamette Falls data set contains information on wild winter steelhead counts from 1993 and represents the total escapement of wild winter steelhead for the Upper

Willamette ESU. Counts at Willamette Falls increased by a factor of three or four beginning in 2001 compared to earlier years. The states' proposal to allow for an increase in the incidental take of listed winter steelhead is premised largely on the improved escapements observed over the last few years.

Molalla River

The Molalla River currently contains three distinct runs of steelhead: native late-run winter steelhead, introduced early-run winter steelhead (from Lower Columbia River populations), and introduced Skamania summer-run steelhead (Chilcote 1997). Releases of the early-run steelhead into the Molalla were discontinued in the mid-1990s (Chilcote 1997). An abundance time series for natural-origin winter steelhead in the Molalla River shows a declining trend from 1984-1996, and an increasing trend since 1997 (Table 3, Figure 1).

North Santiam River

Native late-winter and introduced Skamania summer-run steelhead are both present in the North Santiam River (Chilcote 1997). Surveys done in 1940 estimated that the run of steelhead at the time was at least 2,000 fish (Parkhurst et al. 1950). Parkhurst et al. (1950) also reported that larger runs of steelhead existed in Breitenbush, Little North Santiam, and Marion Fork Rivers, which are tributaries of the North Santiam River. Native steelhead were artificially propagated at the North Santiam Hatchery beginning in 1930, when a record 2,860,500 eggs (686 females @ 4170 eggs/female) were taken (Wallis 1963). The release of hatchery propagated steelhead (late-winter run) in the North Santiam was discontinued in 1998 (NMFS 1999). Recent (through 1994) average escapements to the North Santiam have averaged 1,800 fish of mixed hatchery and natural origin (Busby et al. 1996). An abundance time series based on redd counts data from the North Santiam River show a declining trend from 1984-1995, and a stable, slightly increasing tend since 1996 (Figure 1).

South Santiam River

Index areas for the South Santiam River population are divided into the Lower and Upper reaches. Native late-winter and introduced Skamania summer-run steelhead are both present in the South Santiam River. An abundance time series based on dam counts from the Upper South Santiam River show a low, but stable trend from 1984-2000, and an increasing trend since 2001 (Figure1). An abundance time series based on redd counts from the Lower South Santiam River shows a declining trend from 1984-1997, and a stable, slightly increasing trend since 1998 (Figure1).

Calapooia River

An abundance time series based on redd counts data from the Calapooia River show a declining trend from 1984-1997, and an increasing trend since 1998 (Figure 1).

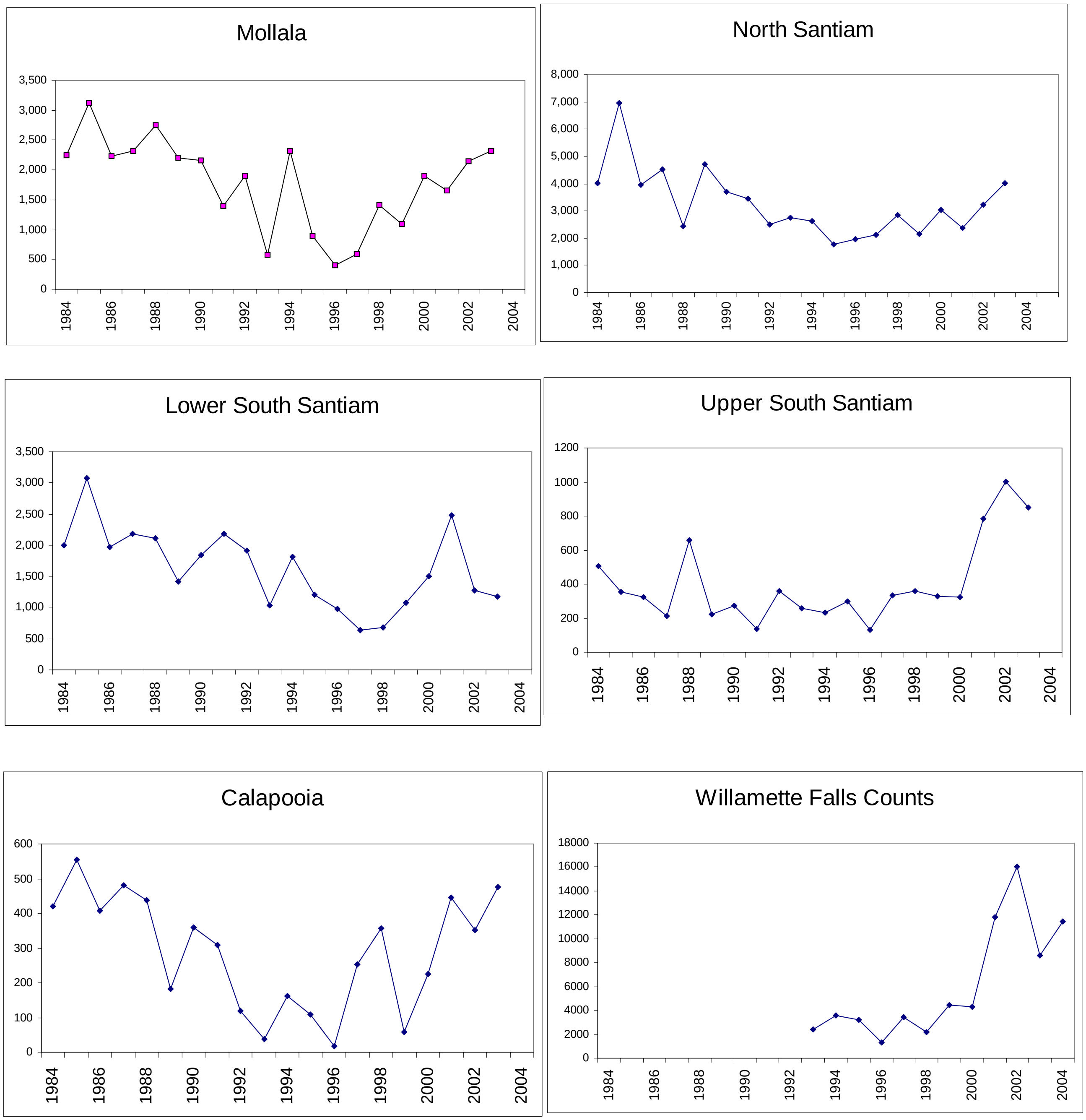
West Side Tributaries

No time series or current counts of spawner abundance for the west side tributaries population are available. It is questionable if there was ever a selfsustaining steelhead population in the west side. There is assumed to be little, if any, natural production of steelhead in these tributaries.

Table 3. Estimated spawner abundance of wild winter steelhead for populations in the Upper Willamette River ESU.

Year	Willamette Falls	Molalla	North Santiam	South Santiam		Calapooia
				Lower	Upper	
1984		2,244	4,010	1,997	504	420
1985		3,129	6,966	3,075	355	555
1986		2,226	3,944	1,964	326	407
1987		2,324	4,523	2,180	214	481
1988		2,757	2,444	2,106	656	439
1989		2,206	4,725	1,411	222	183
1990		2,155	3,707	1,846	272	360
1991		1,398	3,443	2,180	139	309
1992		1,898	2,484	1,906	361	119
1993	2,426	577	2,754	1,032	256	39
1994	3,604	2,321	2,619	1,811	234	161
1995	3,191	898	1,755	1,204	297	109
1996	1,324	398	1,955	972	131	18
1997	3,431	590	2,106	642	336	253
1998	2,179	1,411	2,835	684	359	358
1999	4,414	1,090	2,163	1,076	328	59
2000	4,315	1,898	3,021	1,499	326	225
2001	11,792	1,654	2,375	2,485	783	446
2002	16,039	2,140	3,227	1,274	1,003	351
2003	8,601	2,321	4,010	1,179	850	477
2004	11,433					

Figure 1. Annual spawner abundance estimates for wild winter steelhead populations belonging to the upper Willamette ESU,1984-2003.



Willamette Falls Counts

Counts of natural-origin winter steelhead at Willamette Falls represent the total escapement for the Upper Willamette ESU. Natural-origin winter steelhead counts at Willamette falls averaged 3,100 fish between 1990 and 2000 (range 1,324 - 4,414), and 12,144 fish between 2001 and 2003 (range 8,601 - 16,039) (Table 3). The preseason forecast for Upper Willamette steelhead in 2005 is 12,000 (Kostow 2004) which would be comparable to returns observed in recent years.

LeFleur and Melcher (2004) provided intrinsic productivity values measured for several populations for which adequate recent data existed (e.g., a time series longer than 12 years, known ratios of hatchery and wild spawners, age composition estimates). Intrinsic productivity estimates were developed by fitting a Ricker recruitment model to observed spawner and recruit data sets. The alpha parameter of the Ricker recruitment model, which is determined from the recruitment curve fitting exercise, was estimated for each population and was used as the index of intrinsic productivity. The results for Upper Willamette River winter steelhead populations show a range of intrinsic productivity values from 1.90 to 3.82 recruits per spawner (Table 4). The 95% confidence intervals about these point estimates were quite wide, a result of the relatively poor fit of the data to the assumed recruitment curve. Point estimates and the bounds of confidence for all of the intrinsic productivity estimates were greater than 1.0, which suggests that these populations have the capability to increase when depressed to low levels of abundance.

Table 4. Intrinsic productivity for Upper Willamette winter steelhead populations (LeFleur and King 2004).

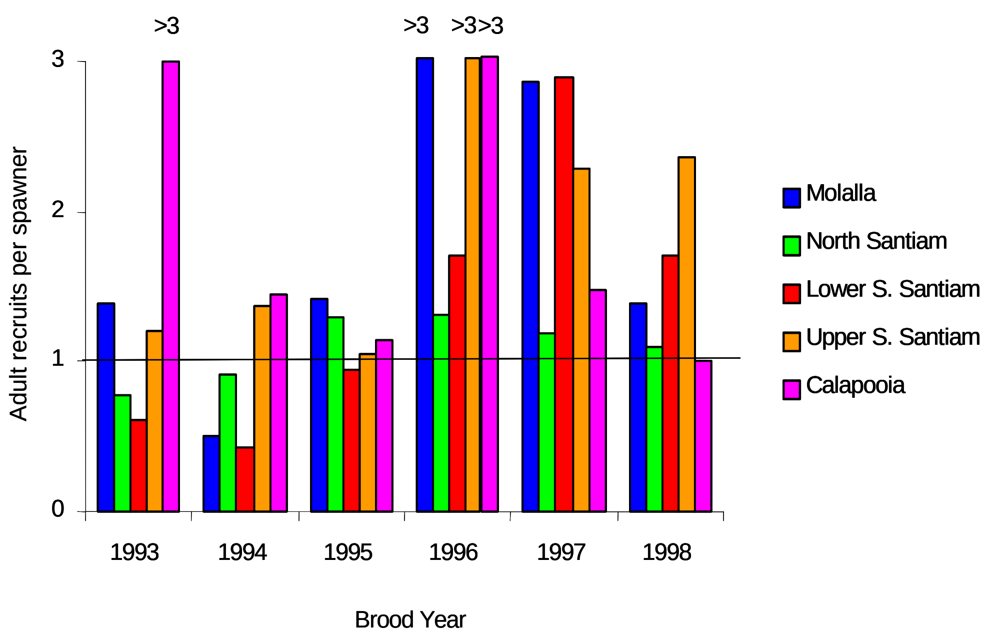
Population	ESU	Sample Brood Years	Ricker Alpha Value	95% CI for Alpha Value
Molalla	UWR	1980-1997	2.64	1.45 – 4.76
North Santiam	UWR	1980-1997	1.90	1.22 – 2.94
Lower South Santiam	UWR	1980-1997	2.46	1.32 – 4.62
Upper South Santiam	UWR	1980-1997	1.95	1.38 – 2.80
Calapooia	UWR	1980-1997	3.82	1.79 – 8.25

As illustrated in Figure 2, the observed number of recruits per spawner for populations belonging to the Upper Willamette ESU during the last three brood years (1996, 1997 and 1998) was generally greater than for the first two brood years of the data set (1993 and 1994). These higher recruitment rates in recent years are also reflected by the higher escapements in recent years.

2.2.1.2 Lower Columbia River Steelhead

The Lower Columbia River ESU includes naturally-produced steelhead returning to Columbia River tributaries on the Washington side between the Cowlitz and Wind rivers in Washington and on the Oregon side between the Willamette and Hood Rivers, inclusive. In the Willamette River, the upstream boundary of this ESU is at Willamette Falls. The Willamette/Lower Columbia Technical Review Team (WLC-TRT) identified historical demographically independent populations (Myers et al. 2002). Myers et al. (2002) hypothesized the ESU historically consisted of 17 winter-run populations and six summer-run populations, for a total of 23 populations. Of the 17 winter-run populations, three (Cispus River, Upper Cowlitz River, and Tilton River) are extirpated (Steel and Sheer 2002). In this supplemental biological opinion, we focus our discussion on the remaining 14 winter steelhead populations because these are the ones affected by the proposed action.

Figure 2. Observed recruits per spawner for four populations of upper Willamette ESU winter steelhead, including two sub-populations for the South Santiam, 1993 to 1997 brood years (LeFleur and Melcher 2004).



A comparison of the current and historically available habitat indicates that habitat has been reduced for most populations. But overall, about 75% or more of the historical habitat remains (Table 5).

Recent abundance time series data are available for nine of the 14 winter-run populations. There is also information for Cedar Creek index area which is a tributary to the North Fork Lewis River. Most of the larger populations in the ESU are represented. The nine populations with abundance data represent 70% of the total potential current habitat in the ESU (from Table 5). Information for these populations is presented in Table 6 and Figure 3.

WDFW has provided escapement goals for six of the eight index areas in Washington state (Table 6 and Figure 3). The states have management related escapement goals for several of the populations. These escapement goals presumably relate to some estimate of desired abundance level, but context for these goals is not defined. Two additional abundance goals were identified through the recent subbasin planning process (LCSRB 2004). The higher goal referred to as PFC represents the theoretical capacity if currently accessible habitat was restored to “proper functioning conditions.” The “high” escapement goal is consistent with a viable state for the population. Of the ten Lower Columbia River indicator stocks, five have been above one or more of the escapement benchmarks in recent years; some by a substantial margin (Figure 3). Other populations are generally below the specified goals despite increases in recent years.

All populations, except the Sandy River population, have experienced an increase in abundance in the last three to four years, compared to the abundance level of the mid-to-late 90's (Table 6 and Figure 3).

The common trend of improved escapement is also apparent from estimates of recruit per spawner for various populations of winter steelhead in the ESU. Broodyear return rates have generally been higher for both Oregon and Washington populations since 1996 (Figures 4 and 5).
LeFleur and King (2004) provided estimates of the intrinsic rate of productivity for several populations for which adequate data existed (e.g., a time series longer than 12 years, known ratios of hatchery and wild spawners, age composition estimates). Intrinsic productivity estimates were developed by fitting a Ricker recruitment model to observed spawner and recruit data sets. The alpha parameter of the Ricker recruitment model, which is determined from the recruitment curve fitting exercise, was estimated for each population and was used as the index of intrinsic productivity. The results for Lower Columbia River winter steelhead populations show a range of intrinsic productivity values from 1.19 to 2.88 recruits per spawner (Table 7). The 95% confidence intervals about these point estimates were quite wide, a result of the relatively poor fit of the data to the assumed recruitment curve. All point estimates for intrinsic productivity were greater than 1.0, which suggests that these populations have the capability to increase when depressed to low levels of abundance. For two populations, the 95% confidence interval included values less than 1.0.

Table 5. Historical populations of Lower Columbia River winter-run steelhead and loss of habitat from barriers[1].

Population	Potential Current Habitat (Km)	Potential Historic Habitat (Km)	Current to Historical Habitat (%)
Cispus River	0	87	0
Tilton River	0	120	0
Upper Cowlitz River	6	358	2
Coweeman River	85	102	84
Lower Cowlitz River	542	674	80
South Fork Toutle River	82	92	89
North Fork Toutle River	209	330	63
Kalama River	112	122	92
North Fork Lewis	115	525	22
East Fork Lewis	239	315	76
Salmon Creek	222	252	88
Washougal River	122	232	53
Clackamas River	919	1,127	82
Sandy River	295	386	76
Lower Gorge Tributaries	46	46	99
Upper Gorge Tributaties	31	31	100
Hood River	138	138	99

[1] The potential current habitat is the kilometers of stream below all currently impassible barriers between a gradient of 0.5% and 4%. The potential historical habitat is the kilometers of stream below historically impassible barriers between a gradient and 0.5% and 6%. The current to-historical habitat ratio is the percent–+--- of the historical habitat that is currently available

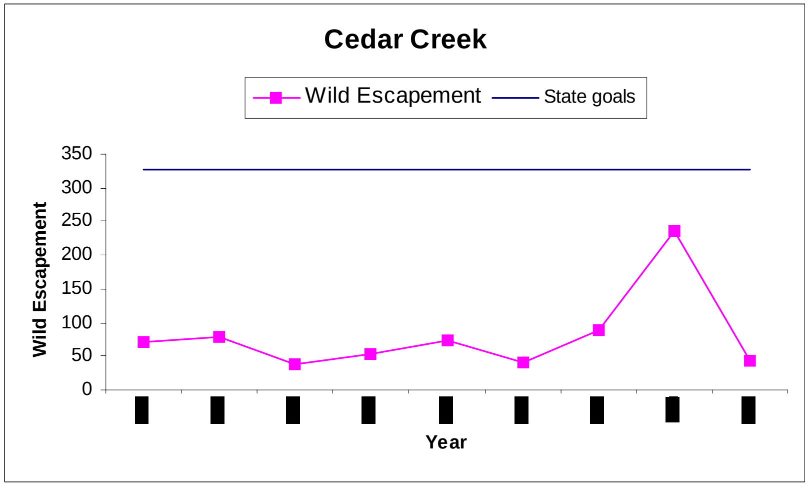
Table 6. Estimated spawner abundance of wild winter steelhead in index areas in Lower Columbia River ESU tributaries, 1984-2003 and related escapement reference points[1].

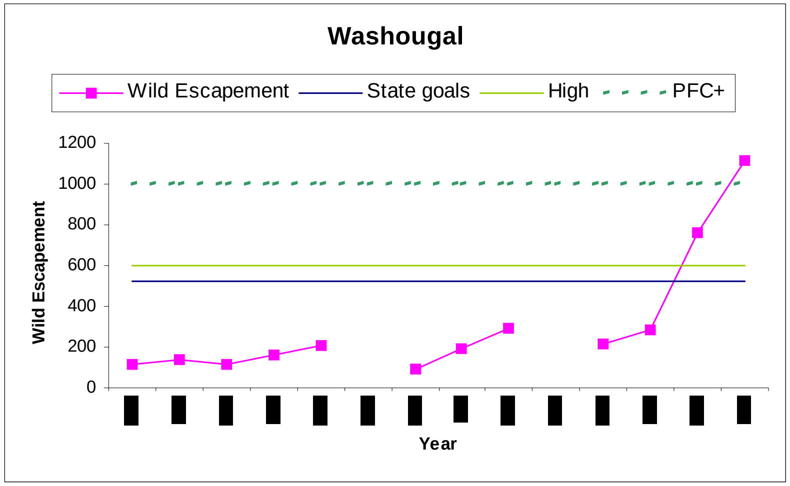
	Washington Tributaries								Oregon Tributaries		
Year	Coweeman	SF Toutle	NF Toutle	Kalama	NF Lewis (Cedar Creek Index)	Washougal	Toutle (Green Index)	EF Lewis Index	Clackamas	Sandy	Hood
1984		836		943					1,238		
1985		1,807		632			775		1,225		
1986		1,595		919				282	1,432		
1987	889	1,650		982			402	192	1,318		
1988	1,088	2,222		1,079			310	258	1,773		
1989	392	1,371	18	506			128	140	1,249		
1990	522	752	36	356			86	102	1,487		
1991		904	108	959		114	108	72	829		
1992		1,290	322	1,974		142	44	88	2,106		697
1993	438	1,242	165	843		118	84	90	1,174		397
1994	362	632	90	725		158	128	78	1,218		378
1995	68	396	175	1,030		206	174	53	1,131		194
1996	44	150	251	725	70		108		203		270
1997	108	388	183	456	78	92	132	192	273		275
1998	486	374	149	413	38	195	118	420	265		209
1999	198	562	133	478	52	294	72	476	133		290
2000	530	490	238	817	73		124		442	742	908
2001	384	348	185	922	41	216	192	328	893	902	1,000
2002	298	858	328	1,355	88	286	180	316	1,328	1,031	1,034
2003	460	1,510	410	1,699	237	764	434	624	1,230	671	717
2004	722	1,212	249	2,150	44	1,114	256	1,298	3,110	870	472
Esc. Goal	**1,064**	**1,058**		**1,000**	**328**	**520**		**204**			
High	**800**	**1,400**	**700**	**600**		**600**		**600**	**1,000**	**1,800**	**1,400**
PFC+	**1,200**	**1,900**	**3,500**	**700**		**1,000**		**1,300**	**2,000**	**3,600**	**2,800**

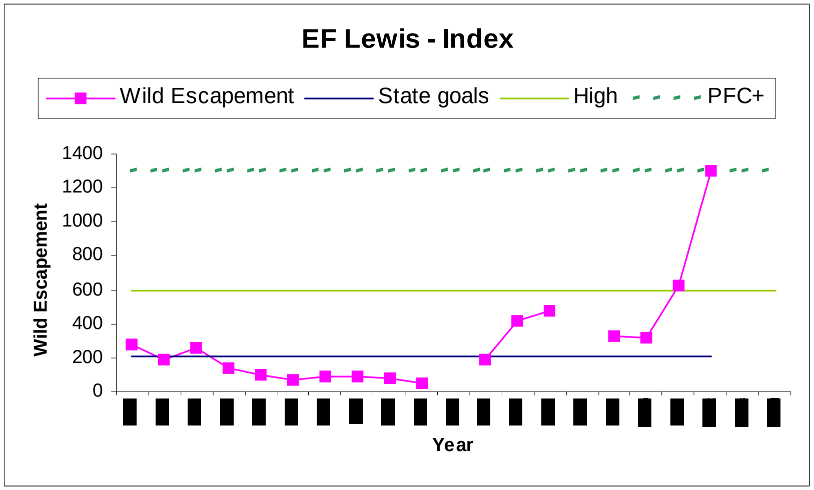
[1]Escapement Goals (LeFleur and Melcher 2004, High and PFC+ (Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan, October 2004 draft)

Figure 3. Annual spawner abundance estimates (or index counts) for wild winter steelhead populations belonging to the Lower Columbia ESU, 1984-2004. Escapement reference points are the same as those shown in Table 6.

Figure 3. Continued







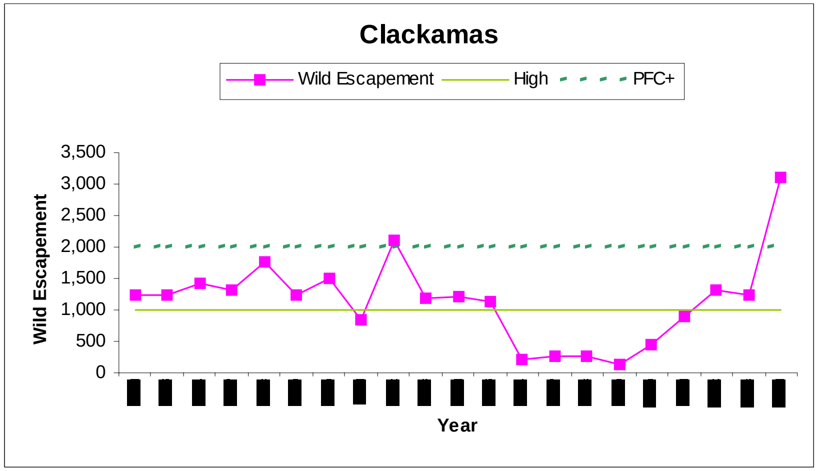
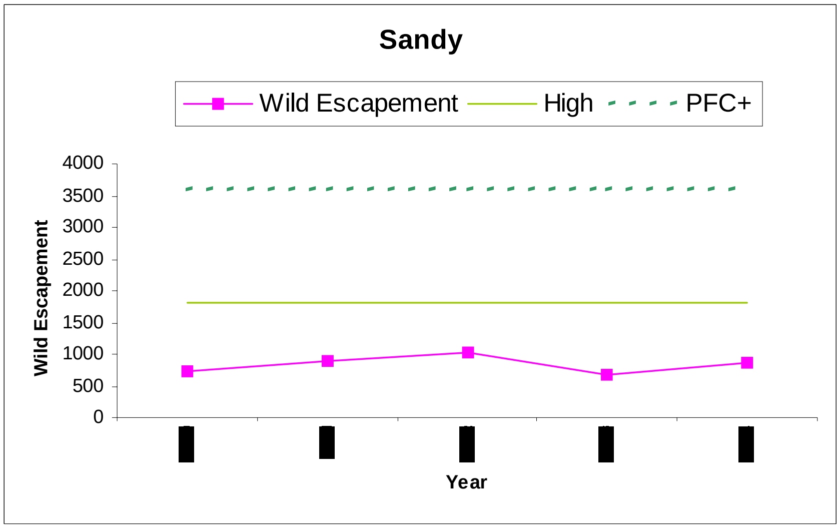


Figure 3. Continued



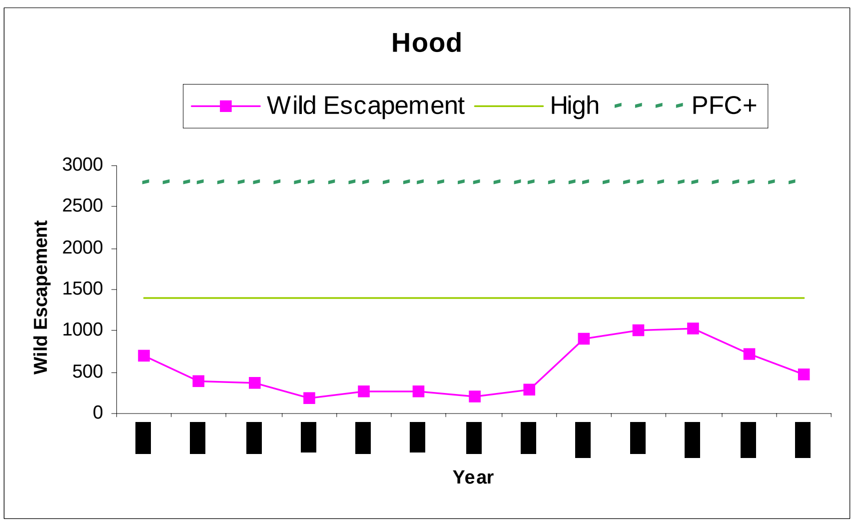


Figure 4. Observed recruits per spawner for three Oregon populations of Lower Columbia River ESU winter steelhead, 1993 to 1999 brood years (LeFleur and Melcher 2004).

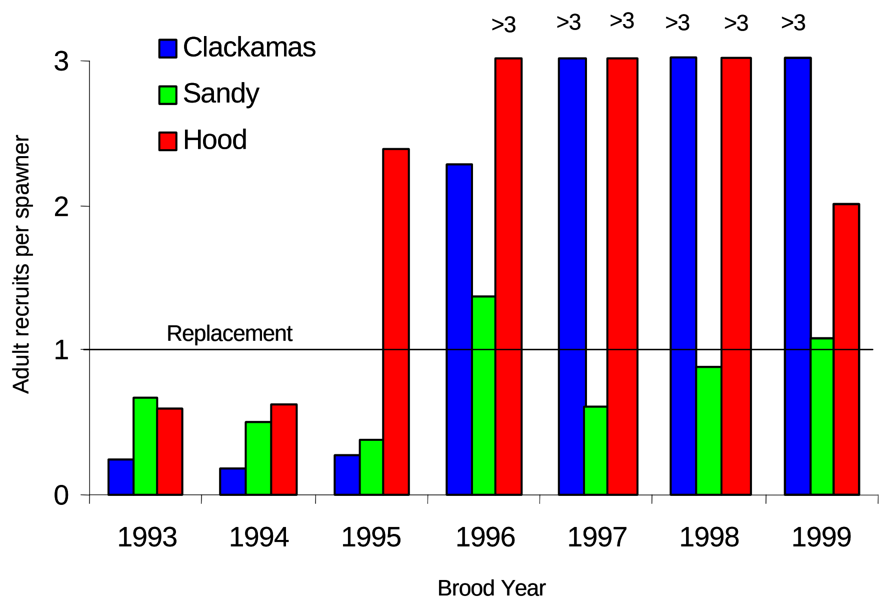


Figure 5. Observed recruits per spawner for four Washington populations of Lower Columbia River ESU winter steelhead, 1993 to 1999 brood years (LeFleur and Melcher 2004).

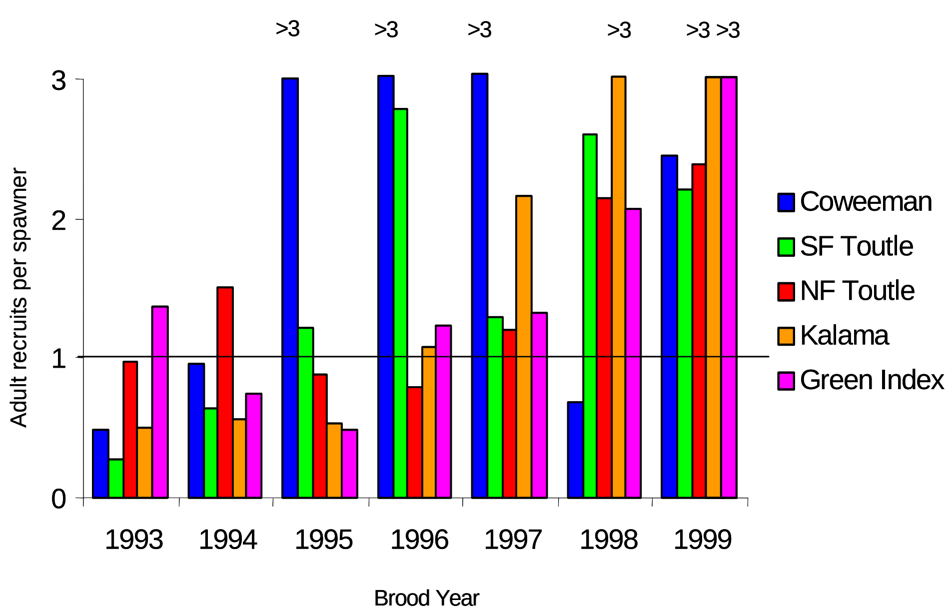


Table 7. Intrinsic productivity for Lower Columbia winter steelhead populations (LeFleur and King 2004).

Population	ESU	Sample Brood Years	Ricker Alpha Value	95% CI for Alpha Vale
NFk Toutle	LCR		2.15	1.87 - 2.48
SFk Toutle	LCR		1.19	0.65 - 2.25
Green River	LCR		2.88	1.99 - 4.17
Kalama	LCR		2.39	1.67 - 3.42
Clackamas	LCR	1980-1997	1.57	0.70 -3.53

The Biological Review Team has provided additional information on the status of the Lower Columbia River steelhead populations as part of the recent review of ESA listing status (BRT 2003). Summary statistics on population trends and growth rate from the BRT report are presented in Table 8 and Table 9. The majority of populations have a long-term (based on 14-25 years) trend less than one, indicating the population is in decline. In addition, there is a high probability for most populations that the true trend/growth rate is less than one (Table 9). Short-term trends are also generally less than 1.0 for most populations. Short-term trend analysis includes information over the last 12 or 13 years. The potential reasons for these declines have been cataloged in the WLC-TRT status reviews and include habitat degradation, deleterious hatchery practices, and climate-driven changes in marine survival (BRT 2003).

The BRT report shows declining trends over time, both short-term and long-term. The states base their proposal for a higher mortality rate in 2005 on reported increases of abundance over the last 3-5 years for most populations and the expectation that returns in 2005 will also be higher and comparable to those in recent years. These observations are not inconsistent, but are, instead, based on different time frames. The distinction between the BRT's conclusions relative to "short-term" trends and the conclusion that abundance is significantly higher in more recent years is best shown by the graphics in Figures 1 and 3.

Table 8. Trend and growth rate for subset of Lower Columbia winter steelhead populations. 95% confidence intervals are in parentheses. The long-term analysis used the entire data set (see table B.2.4.2 in the BRT report for years). The criteria for the short-term data set is defined in the methods section. In the “Hatchery = 0” columns, the hatchery fish are assumed to have zero reproductive success. In the “Hatchery = Wild” columns, hatchery fish are assumed to have the same relative reproductive success as natural origin fish (BRT 2003).

Population	Long-Term Analysis			Short-Term Analysis		
	Trend (C.I.)	Lamda (C.I.)		Trend (C.I.)	Lambda (C.I.)	
		Hatchery = 0	Hatchery =Wild		Hatchery = 0	Hatchery =Wild
Coweeman River	0.916 (0.847-0.990)	0.908 (0.792-1.041)	0.742 (0.678-0.903)	0.941 (0.818-1.083)	0.920 (0.803-1.055)	0.787 (0.682-0.909)
South Fork Toutle River	0.917 (0.876-0.961)	0.938 (0.830-1.059)	0.933 (0.821-1.061)	0.94 (0.879-1.006)	0.933 (0.826-1.054)	0.929 (0.817-1.056)
North Fork Toutle River	1.135 (1.038-1.242)	1.062 (0915-1.233)	1.062 (0.915-1.233)	1.086 (0.999-1.18)	1.038 (0.894-1.206)	1.038 (0.894-1.206)
Kalama River	0.998 (0.973-1.023)	1.10 (0.913-1.117)	0.916 (0.824-1.019)	1.004 (0.923-1.091)	0.984 (0.890-1.088)	0.922 (0.829-1.025)
Clackamas River	0.979 (0.966-0.933)	0.971 (0.901-1.047)	0.949 (0.877-1.027)	0.914 (0.806-1.036)	0.875 (0.812-0.943)	0.830 (0.767-0.898)
Sandy River	0.940 (0.919-0.960)	0.945 (0.85-1.051)	0.828 (0.741-0.925)	0.889 (0.835-0.946)	0.866 (0.797-0.985)	0.782 (0.700-0.874)

Table 9. Probability the trend or growth rate is less than one. In the “Hatchery = 0” columns, the hatchery fish are assumed to have zero reproductive success. In the “Hatchery = Wild” columns, hatchery fish are assumed to have the same relative reproductive success as natural origin fish (BRT 2003).

Population	Long-Term Analysis			Short-Term Analysis		
	Trend	Lamda		Trend	Lambda	
		Hatchery = 0	Hatchery =Wild		Hatchery = 0	Hatchery =Wild
Coweeman River	0.985	0.936	1.000	0.822	0.851	0.995
South Fork Toutle River	0.999	0.884	0.899	0.919	0.797	0.812
North Fork Toutle River	0.005	0.063	0.063	0.026	0.135	0.135
Kalama River	0.574	0.405	0.971	0.463	0.593	0.846
Clackamas River	0.998	0.784	0.918	0.929	0.849	0.929
Sandy River	1.000	0.993	1.000	0.999	0.991	1.000

2.2.1.3 Middle Columbia River Steelhead

The Middle Columbia River Steelhead ESU includes steelhead populations in Oregon and Washington drainages upstream of the Hood and Wind river systems to and including the Yakima River. The Snake River is not included in this ESU. Major drainages in this ESU are the Deschutes, John Day, Umatilla, Walla-Walla, Yakima, and Klickitat river systems. Almost all steelhead populations within this ESU are summer-run fish, the exceptions being winter-run components returning to the Klickitat, and Fifteen Mile Creek watersheds (BRT 2003). Most of the populations within this ESU are characterized by a balance between 1- and 2-year-old smolt outmigrants. Adults return after 1 or 2 years at sea.

There is relatively little data available for the winter populations of the Middle Columbia River ESU. However, recent year (1999-2001) redds-per-mile estimates of winter steelhead escapement in Fifteen Mile Creek were up substantially relative to the annual levels in the early 1990's (BRT 2003). Trend or count information for the Klickitat River winter steelhead run are not available but current return levels are believed to be below the interim target level (BRT 2003).

2.2.1.4 Winter Steelhead Forecast for 2005

The forecast for the combined listed natural-origin winter steelhead populations of the three affected ESUs for 2005 is 27,000 (TAC 2004). This forecast includes 12,000 for the Upper Willamette ESU, 4,000 for other Oregon tributaries and 11,000 for Washington tributaries.

2.3 Factors affecting the Environmental Baseline

Environmental baselines for biological opinions are defined by regulation at 50 CFR 402.02, which states that an environmental baseline is the physical result of all past and present state, Federal, and private activities in the action area along with the anticipated impacts of all proposed Federal projects in the action area (that have already undergone formal or early section 7 consultation). The environmental baseline for this biological opinion is therefore the result of the impacts a great many activities (summarized below) have had on the listed ESUs' survival and recovery. Put another way, the baseline is the culmination of the effects that multiple activities have had on the species' *biological requirements* and, by examining those individual effects, it is possible to describe more fully the species' status in the action area.

Many of the biological requirements for listed ESUs in the action area can best be expressed in terms of essential habitat features. That is, the ESU requires adequate: (1) substrate (especially spawning gravel), (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) migration conditions (February 16, 2000, 65 FR 7764). The best scientific information presently available demonstrates that a multitude of factors, past and present, have contributed to the decline of west coast salmonids by adversely affecting these essential habitat features. NMFS reviewed much of that information in its reinitiated Consultation on Operation of the Federal Columbia River Power System (FCRPS)(NMFS 2000). Information describing the environmental baseline is summarized in the following sections. NMFS again reviewed and summarized the environmetal baseline in its more recent consultation on the FCRPS (NMFS 2004)

2.3.1 The Hydropower System and Flood Control Dams

Hydropower development on the Columbia River and its tributaries has dramatically affected anadromous salmonids in the basin. Dams have eliminated spawning and rearing habitat and altered the natural hydrograph of the Columbia River – decreasing spring and summer flows and increasing fall and winter flows. Power operations cause flow levels and river elevations to fluctuate – slowing fish movement through reservoirs, altering riparian ecology, and stranding fish in shallow areas. The dams in the migration corridors kill smolts and adults and alter their migrations. The dams have also converted the once-swift river into a series of slow-moving reservoirs – slowing the smolts' journey to the ocean and creating habitat for predators.

Of the affected ESUs, only three of the LCR winter steelhead populations and two MCR winter steelhead populations must navigate past major hydroelectric projects during their up- and downstream migrations. Because of these migrations and the fact that all the populations experience the effects of other dam operations occurring upstream from their ESU boundary, all three ESUs are subject to all the impacts described above. For more information on the effects of the mainstem hydropower system, please see NMFS (2004).

For the UWR winter steelhead populations, the construction and operation of the Federal flood control dams in the Willamette Basin has significantly influenced the status of listed species and their habitat. From 1952 to 1968, the Corps constructed 13 dams on all of the major east side tributary streams to the Willamette River above the Falls, blocking over 400 miles of stream habitat previously accessible to spring Chinook salmon and winter steelhead (ODFW and WDFW 1999). Most of the dams do not have fish passage or the facilities are inadequate for unimpeded passage upstream and downstream.

In addition to the elimination of the majority of anadromous fish habitat, the operation of the dams has significantly affected the life history, distribution, and survival of the remaining natural-origin populations of winter steelhead. The occurrence and magnitude of floods events has been significantly altered in the Willamette Basin (Figure 6). This change has implications to nutrient input, stream habitat dynamics, and the survival of juvenile fish. Current flow regimes in the Willamette Basin are counter to the natural regimes observed historically. Winter and spring water releases from the dams are warmer and of lower discharge, which has accelerated egg development and fish emerge earlier than what occurred historically. Summer flows are higher and cooler than historically. In the fall, flows are relatively high because the dams are being drawn down in preparation for the next year's winter run-off into the reservoirs.

However, ongoing biological opinions from NMFS to the Bonneville Power Administration (BPA), the U.S. Army Corps of Engineers (USACE), the USFWS, and the Bureau of Reclamation (BOR) have brought about numerous beneficial changes in the operation and configuration of the Willamette River hydropower system. For example, increased spill at the dams allows smolts to avoid both turbine intakes and bypass systems; increased flow in the mainstem Willamette and Columbia Rivers provides better inriver conditions for smolts; and better smolt transportation, through the addition and modification of barges in the Columbia River.

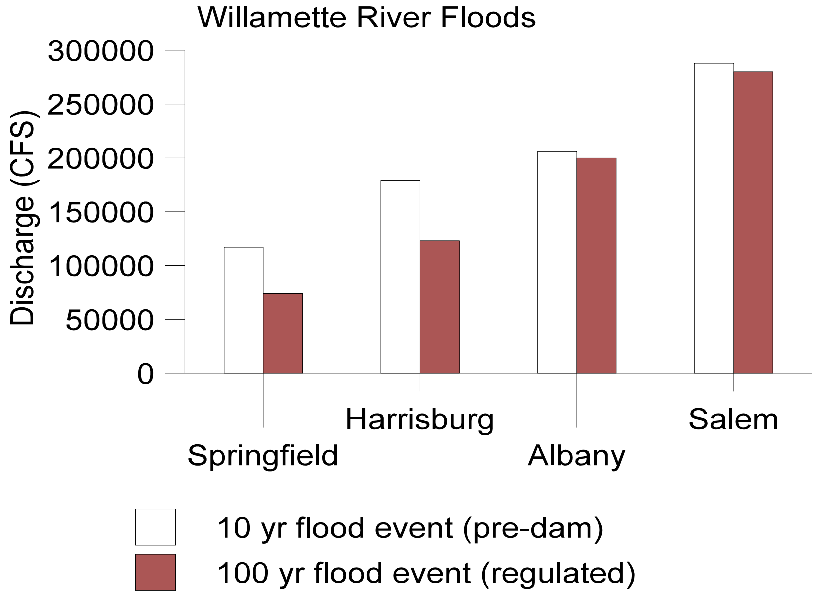


Figure 6. Comparison of the magnitude and frequency of floods before dam development and under current dam regulation at four locations on the mainstem Willamette River. Floods events that, on average, recurred every ten years during pre-dam development, now occur at a lower magnitude every 100 years (Data from Benner and Sedell 1997)

2.3.2 Human-Induced Habitat Degradation

The quality and quantity of freshwater habitat in much of the Columbia River Basin , including the Willamette sub-basin, have declined dramatically in the last 150 years. Forestry, farming, grazing, road construction, hydropower development, mining, and urban development have radically changed the historical habitat conditions of the basin. With the exception of fall Chinook salmon, which generally spawn and rear in the mainstem rivers, salmon and steelhead spawning and rearing habitat is found in the tributaries to the Columbia and Willamette Rivers.

A major player in salmonid habitat degradation, urban development in the Willamette Valley followed agriculture which was also damaging. Ninety-six percent of Oregon’s population resided in Portland in the 1850s. By the 1930’s there were twenty-one incorporated cities in the valley, and by the 1990’s, there were over 70 incorporated cities (Hulse 1998). In the Metro region, there are an estimated total of 8,840 structures in or close to the floodplain, and approximately 1,080 household units were built in or close to the floodplain between 1992 and 1995. The Willamette floodplain has been dammed, diked, drained, filled, and confined to the point that it no longer functions as a healthy ecosystem with the capacity to support native fish and wildlife, absorb and reduce the impact of flooding, and filter contaminants (Allen et. al, 1999). Tributary water quality problems contribute to poor water quality when sediment and contaminants from the tributaries settle in mainstem reaches and the estuary.

Over 2,500 streams and river segments and lakes do not meet Federally-approved, state and Tribal water quality standards and are now listed as water-quality-limited under Section 303(d) of the Clean Water Act (CWA). Most of the water bodies in Oregon and Washington on the 303(d) list do not meet water quality standards for temperature. High water temperatures adversely affect salmonid metabolism, growth rate, and disease resistance, as well as the timing of adult migrations, fry emergence, and smoltification. Many factors can cause high stream temperatures, but they are primarily related to land-use practices rather than point-source discharges. Some common actions that cause high stream temperatures are the removal of trees or shrubs that directly shade streams, water withdrawals for irrigation or other purposes, and warm irrigation return flows. Loss of wetlands and increases in groundwater withdrawals contribute to lower base-stream flows, which in turn contribute to temperature increases. Activities that create shallower streams (e.g., channel widening) also cause temperature increases.

Pollutants also degrade water quality. Many waterways in the Willamette River Basin fail to meet the CWA and Safe Drinking Water Act (SDWA) water quality standards due to the presence of pesticides, heavy metals, dioxins and other pollutants (Willamette River Basin Task Force 1997). These pollutants originate from both point sources (industrial and municipal waste) and nonpoint sources (agriculture, forestry, urban activities, etc.). The types and amounts of compounds found in runoff are often correlated with land use patterns (e.g. fertilizers and pesticides are found frequently in agricultural and urban settings, and nutrients are found in areas with human and animal waste). People contribute to chemical pollution in the basin, but natural and seasonal factors also influence pollution levels in various ways.

Nutrient and pesticide concentrations vary considerably from season to season, as well as among regions with different geographic and hydrological conditions. Natural features (such as geology and soils) and land-management practices (such as storm water drains, tile drainage and irrigation) can influence the movement of chemicals over both land and water (Allen et al. 1999). Salmon require clean gravel for successful spawning, egg incubation, and the emergence of fry. Fine sediments clog the spaces between gravel and restrict the flow of oxygen-rich water to the incubating eggs. Excess nutrients, low levels of dissolved oxygen, heavy metals, and changes in pH also directly affect the water quality for salmon and steelhead.

Water quantity problems are also a significant cause of habitat degradation and reduced fish production. Millions of acres of land in the basins are irrigated. Although some of the water withdrawn from streams eventually returns as agricultural runoff or groundwater recharge, crops consume a large proportion of it. Withdrawals affect seasonal flow patterns by removing water from streams in the summer (mostly May through September) and restoring it to surface streams and groundwater in ways that are difficult to measure. Withdrawing water for irrigation, urban consumption, and other uses increases temperatures, smolt travel time, and sedimentation. Return water from irrigated fields can introduce nutrients and pesticides into streams and rivers.

Deficiencies in water quantity have impacted the McKenzie, mainstem Willamette, and Lower Columbia Rivers, all of which have experienced major agricultural development over the last century. Water withdrawals (primarily for irrigation) have lowered summer flows in nearly every stream in the basin and profoundly decreased the amount and quality of rearing habitat (Allen et al. 1999). In fact, in 1993, fish and wildlife agency, Tribal, and conservation group experts estimated that 80 percent of 153 Oregon tributaries had low-flow problems with two-thirds caused, at least in part, by irrigation withdrawals (OWRD 1993). The Northwest Power Planning Council (NWPPC) showed similar problems in many Oregon and Washington tributaries (NWPPC 1992).

Blockages that stop downstream and upstream fish movement exist at many dams and barriers, whether they are for agricultural, hydropower, municipal/industrial, or flood control purposes. Culverts that are not designed for fish passage also block upstream migration. Migrating fish are sometimes killed by being diverted into unscreened or inadequately screened water conveyances or turbines. While many fish-passage improvements have been made in recent years, manmade structures continue to block migrations or kill fish throughout the Columbia and Willamette basins.

On the landscape scale, human activities have affected the timing and amount of peak water runoff from rain and snowmelt. Forest and range management practices have changed vegetation types and density which, in turn, affect runoff timing and duration. Many riparian areas, flood plains, and wetlands that once stored water during periods of high runoff have been destroyed by development that paves over or compacts soil—thus increasing runoff and altering their natural hydrograph pattern. Land ownership has also played its part in the region's habitat and land-use changes. Federal lands, which compose 50 percent of the Willamette basin, are generally forested and are situated in the upstream portions of the watersheds. While there is substantial habitat degradation across all land ownership types, in general, habitat quality in many headwater stream sections is in better condition than in the largely non-Federal lower portions of tributaries (Doppelt et al. 1993, Frissell 1993, Henjum et al. 1994, Quigley and Arbelbide 1997). In the past, valley bottoms were among the most productive fish habitats in the basin (Stanford and Ward 1992, Spence et al. 1996, Independent Science Group (ISG) 1996). Today agricultural and urban land development and water withdrawals have significantly altered the habitat for fish and wildlife. Streams in these areas typically have high water temperatures, sedimentation problems, low flows, simplified stream channels, and reduced riparian vegetation.

At the same time habitat was being destroyed by water withdrawals in the Columbia basin and Willamette sub-basin, water impoundments in other areas dramatically reduced threatened ESU habitat by inundating large amounts of spawning and rearing habitat and reducing migration corridors, for the most part, to a single channel. Flood plains have been reduced in size, offchannel habitat features have been lost or disconnected from the main channel, and the amount of large woody debris (large snags/log structures) in rivers has been reduced. Most of the remaining habitats are affected by flow fluctuations associated with reservoir management.

The Columbia River estuary, through which all the basin's anadromous species must pass, has also been changed by human activities. Historically, the downstream half of the estuary was a dynamic environment with multiple channels, extensive wetlands, sandbars, and shallow areas. The mouth of the Columbia River was about four miles wide, today it is two. Winter and spring floods, low flows in late summer, large woody debris floating downstream, and a shallow bar at the mouth of the Columbia River kept the environment dynamic. Today navigation channels have been dredged, deepened, and maintained. Jetties and pile-dike fields have been constructed to stabilize and concentrate flow in navigation channels. Marsh and riparian habitats have been filled and diked, and causeways have been constructed across waterways. These actions have decreased the width of the mouth of the Columbia River to two miles and increased the depth of the Columbia River channel at the bar from less than 20 to more than 55 feet.

More than 50 percent of the original marshes and spruce swamps in the estuary have been converted to industrial, transportation, recreational, agricultural, or urban uses. More than 3,000 acres of intertidal marsh and spruce swamps have been converted to other uses since 1948 (Lower Columbia River Estuary Program [LCREP] 1999). Many wetlands along the shore in the upper reaches of the estuary have been converted to industrial and agricultural lands after levees and dikes were constructed. Furthermore, water storage and release patterns from reservoirs upstream of the estuary have changed the seasonal pattern and volume of discharge. The peaks of spring/summer floods have been reduced, and the amount of water discharged during winter has increased.

Human-caused habitat alterations have also increased the number of predators feeding on listed fish. A population of terns on Rice Island (16,000 birds in 1997) consumed an estimated 6 to 25 million outmigrating salmonid smolts during 1997 (Roby et al.1998) and 7 to 15 million outmigrating smolts during 1998 (Collis et al. 1999). Rice Island is a dredged material disposal site in the Columbia River estuary, created by the USACE under its Columbia River Channel Operation and Maintenance Program.

As another example, populations of Northern pikeminnow (Ptychocheilus oregonensis—a voracious salmonid predator) in the Columbia River have proliferated in the warm, slow-moving reservoirs created by mainstem dams. Some researchers have estimated the pikeminnow population in the John Day pool alone to be over one million (Bevan et al. 1994) and they all consume salmonids if given the opportunity.

To counteract all the ill effects listed in this section, Federal, state, tribal, and private entities have, singly and in partnership, begun recovery efforts to help slow and, eventually, reverse the decline of salmon and steelhead populations. Notable efforts within the range of the ESUs under this biological opinion are the Basinwide Recovery Strategy (Federal Caucus 2000), the Northwest Forest Plan (NFP), PACFISH, the Washington Wild Stock Restoration Initiative, the Oregon Plan for Salmon and Watersheds (OPSW), and the Washington Wild Salmonid Policy. Nevertheless, much remains to be done to recover salmonids in the Columbia River basin. Full discussions of these efforts can be found in the referenced documents and in the FCRPS biological opinions.

2.3.3 Hatcheries

For more than 100 years, hatcheries in the Pacific Northwest have been used to (a) produce fish for harvest and (b) replace natural production lost to dam construction and other development—not to protect and rebuild naturally-produced salmonid populations. As a result, most salmonid populations in the region are primarily derived from hatchery fish. In 1987, for example, 95 percent of the coho salmon, 70 percent of the spring Chinook salmon, 80 percent of the summer Chinook salmon, 50 percent of the fall Chinook salmon, and 70 percent of the steelhead returning to the Columbia River Basin, including the Lower Columbia River and Willamette sub-basins, originated in hatcheries (CBFWA 1990). Hatchery percentage estimates, proportions of hatchery fish relative to total run size, by sub-basin are: UWR steelhead are 24% in the Molalla, 17% in the North Santiam, 5% to 12% in the South Santiam, and less than 5% in the Calapooia (Chilcote 1997, 1998), LCR steelhead are 92% in the Cowlitz River, and 77% in the Kalama River, 50% in the North Fork Washougal River, 0% in the mainstem Washougal River, and 0% to 1% in the North Fork Toutle and Wind rivers (NMFS 2000a).

Because hatcheries have traditionally focused on providing fish for harvest and replacing declines in native runs (and generally not carefully examined their own effects on local populations), it is only recently that the substantial effects of hatcheries on native naturally produced populations been demonstrated. For example, the production of hatchery fish, among other factors, has contributed to the 90 percent reduction in naturally produced coho salmon runs in the Lower Columbia River over the past 30 years (Flagg et al. 1995).

Hatchery fish can harm native, naturally produced-run salmon and steelhead in four primary ways: (1) ecological effects, (2) genetic effects, (3) overharvest effects, and (4) masking effects (NMFS 2000a). Ecologically, hatchery fish can predate on, displace, and compete with naturally produced fish. These effects are most likely to occur when fish are released in poor condition and do not migrate to marine waters, but rather remain in the streams for extended rearing periods. Hatchery fish also may transmit hatchery-borne diseases, and hatcheries themselves may release disease-carrying effluent into streams. Hatchery fish can affect the genetic composition of native fish by interbreeding with them. Interbreeding can also result from the introduction of stocks from other areas. Theoretically, interbred fish are less adapted to the local habitats where the original native stock evolved and are therefore less productive there.

In many areas, hatchery fish provide increased fishing opportunities. However, when naturally produced fish mix with hatchery stocks in these areas, smaller or weaker naturally produced stocks can be over harvested. Moreover, when migrating adult hatchery and naturally produced fish mix on the spawning grounds, the health of the naturally produced runs and the habitat's ability to support them can be overestimated because the hatchery fish mask the surveyors' ability to discern naturally produced run conditions.

The role hatcheries play in the Columbia basin is being redefined by NOAA Fisheries' proposed hatchery listing policy, developing environmental impact statements, and recovery planning efforts. These efforts will focus on maintaining and improving ESU viability. Research designed to clarify interactions between natural and hatchery fish and quantify the effects of artificial propagation on natural fish will play a pivotal role in informing these efforts. The final facet of these initiatives is to use hatcheries to create fishing opportunities that are benign to listed populations (e.g., terminal area fisheries).

2.3.4 Harvest

Steelhead have been harvested in the Columbia basin and Willamette sub-basin as long as there have been people there. Commercial fishing developed rapidly with the arrival of European settlers and the advent of canning technologies in the late 1800s. The development of non-Indian fisheries began in about 1830; by 1861, commercial fishing was an important economic activity. The early commercial fisheries used gill nets, seines hauled from shore, traps, and fish wheels. Later, purse seines and trolling(using hook and line) fisheries developed. Recreational (sport fishing) harvest began in the late 1800s, occurring primarily in tributary locations (ODFW and WDFW 1998). Though steelhead and chum salmon were never as important a component of the Columbia basin's fisheries as Chinook salmon, net-based fisheries generally do not discriminate among species, so it can fairly be said that harvest has also contributed to the decline of all salmonid ESUs.

Salmonids' capacity to produce more adults than are needed for spawning offers the potential for sustainable harvest of naturally-produced (versus hatchery-produced) fish. This potential can be realized only if two basic management requirements are met: (1) enough adults return to spawn and perpetuate the run, and (2) the productive capacity of the habitat is maintained. Catches may fluctuate in response to such variables as ocean productivity cycles, periods of drought, and natural disturbance events, but as long as the two management requirements are met, fishing may be sustained indefinitely. Unfortunately, both prerequisites for sustainable harvest have been violated routinely in the past. The lack of coordinated management across jurisdictions, combined with competitive economic pressures to increase catches or to sustain them in periods of lower production, resulted in harvests that were too high and escapements that were too low. At the same time, habitat has been increasingly degraded, reducing the capacity of the salmon stocks to produce numbers in excess of their spawning escapement requirements.

For years, the response to declining catches was hatchery construction to produce more fish. Because hatcheries require fewer adults to sustain their production, harvest rates in the fisheries were allowed to remain high, or even increase, further exacerbating the effects of overfishing on the naturally-produced (non-hatchery) runs mixed in the same fisheries. More recently, harvest managers have instituted reforms including weak stock, abundance-based, harvest rate, and escapement-goal management. As with improvements being made in other phases of the life histories, it will take some time for these (and future) measures to contribute greatly to the species recovery, but the effort has begun.

2.3.4.1 Ocean Harvest

Ocean harvest also affect listed salmonids. For example, at one point it was estimated that unauthorized high seas drift net fisheries harvested between two percent and 38 percent of the steelhead destined to return to the Pacific Coast of North America (Cooper and Johnson 1992). However, since drift nets were outlawed in 1987, and enforcement has increased, that percentage has probably decreased. Other ocean fisheries, such as West Coast Groundfish Fisheries regulated under the Magnuson-Stevens Act, are required to minimize their salmon by-catch. Steelhead are rarely caught in ocean fisheries and therefore ocean harvest is not considered a significant source of mortality to any of the listed steelhead ESUs considered in this biological opinion (Lohn and McInnis 2003).

2.3.4.2 Columbia Basin Harvest

There is some harvest of listed steelhead that occurs within the action area, but outside the mainstem Columbia River which is the focus of the proposed action. This includes tributary recreational fisheries that are being considered separately under section 4(d) of the ESA.

No commercial fishing is allowed in the tributary areas. Catch-and-release of all unmarked steelhead is required in recreational fisheries. Some mortality occurs associated with catch-and-release of natural-origin steelhead. Mortality rates are population specific since these on effort and encounter rates in each tributary area. Additional mortality associated with these recreational fisheries is on the order of 2% or less.

2.3.5 Natural Conditions

Natural changes in the freshwater and marine environments play a major role in salmonid abundance. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20- to 30-year cycles of climatic conditions and ocean productivity (Francis and Hare (1997). This phenomenon has been referred to as the Pacific Decadal Oscillation. In addition, large-scale climatic regime shifts, such as El Niño, appear to change ocean productivity. During the first part of the 1990s, much of the Pacific Coast was subject to a series of very dry years. On occasion, severe flooding has adversely affected some stocks (e.g., the low returns of Lewis River bright fall Chinook salmon in 1999).

A key factor affecting many West Coast stocks has been a general 30-year decline in ocean productivity. The mechanism whereby stocks are affected is not well understood, partially because the pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean timing and distribution. It is presumed that survival is driven largely by events occurring between ocean entry and recruitment to a subadult life stage. One indicator of early ocean survival can be computed as a ratio of coded-wire tag (CWT) recoveries from subadults relative to the number of CWTs released from that brood year. Time-series of survival rate information for Lewis River fall Chinook salmon and Skagit fall Chinook salmon show highly variable or declining trends in early ocean survival, with very low survival rates in recent years (personal communication with D. Simmons, NMFS, 2003). Since the late 1990s, ocean conditions have improved which has contributed to the increase in abundance observed in recent years for some populations, especially in the Columbia River.

Steelhead are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Ocean predation may also contribute to significant natural mortality, although it is not know to what degree. In general, salmonids are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebound of seal and sea lion populations—following their protection under the Marine Mammal Protection Act of 1972—has caused a substantial number of salmonid deaths. In recent years, for example, sea lions have learned to target Upper Willamette River spring Chinook salmon in the fish ladder at Willamette Falls.

2.3.6 Scientific Research

ESA-listed and other fish in the Lower Columbia River basin and Willamette River sub-basin, are the subject of scientific research and monitoring activities. Most biological opinions NMFS issues recommend specific monitoring, evaluation, and research projects to gather information to aid the survival of listed fish. In addition, NMFS has issued numerous research permits authorizing takes of ESA-listed fish over the last few years. Each authorization for take by itself would not lead to decline of the species. However the sum of the authorized takes indicate a high level of research effort in the action area, and as anadromous fish stocks have continued to decline, the proportion of fish handled for research/monitoring purposes has increased. The effect of these activities is difficult to assess because despite the fact that fish are harassed and even killed in the course of scientific research, these activities have a great potential to benefit ESA-listed salmon and steelhead. For example, aside from simply increasing what is known about the listed species and their biological requirements, research is essentially the only way to answer key questions associated with difficult resource issues that crop up in every management arena and involve every salmonid life history stage (particularly the resource issues discussed in the previous sections). Perhaps most importantly, the information gained during research and monitoring activities can help resource managers recover listed species. That is, no rational resource allocation or management decisions can be made without the knowledge to back them up. Further, there is no way to tell if the corrective measures described in the previous sections are working unless they are monitored and no way to design new and better ones if research is not done.

In any case, scientific research and monitoring efforts (unlike the other factors described in the previous sections) are not considered to be a factor contributing to the decline of listed salmonids, and NMFS believes that the information derived from the research activities is essential to their survival and recovery. Nonetheless, fish are harmed during research activities. And activities that are carried out in a careless or undirected fashion are not likely to benefit the species at all. Therefore, to reduce adverse effects from research activities on the species, NMFS imposes conditions in its permits so that Permit Holders conduct their activities in such a way as to minimize adverse effects on the ESA-listed species, including keeping mortalities as low as possible. Also, researchers are encouraged to use non-listed fish species and hatchery fish instead of listed naturally-produced fish when possible. In addition, researchers are required to share fish samples, as well as the results of the scientific research, with other researchers and co-managers in the region as a way to avoid duplicative research efforts and to acquire as much information as possible from the ESA-listed fish sampled. NMFS also works with other agencies to coordinate research and thereby prevent duplication of effort.

In general, for projects that require a section 10(a)(1)(A) permit, applicants provide NMFS with high take estimates to compensate for potential inseason changes in research protocols, accidental catastrophic events, and the annual variability in listed fish numbers. Also, most research projects depend on annual funding and the availability of other resources. So, a specific research project for which take of ESA-listed species is authorized by a permit may be suspended in a year when funding or resources are not available. As a result, the overall take in a given year for all research projects, as provided to NMFS in post-season annual reports, is usually less than the authorized level of take in the permits and the related NMFS biological opinion on the issuance of those permits. Therefore, because actual take levels tend to be lower than authorized takes, the severity of effects to the ESA-listed species due to the conduct of scientific research activities are usually less than the effects analyzed in a typical biological opinion.

2.3.7 Summary

In conclusion, the picture of whether biological requirements are being met is more clear-cut for habitat related parameters than it is for population factors. Given all the factors for decline—even taking into account the conservation measures being implemented—it is still clear that the biological requirements for Upper Willamette River, Lower Columbia River steelhead, and Middle Columbia River steelhead ESUs are currently not being met under the environmental baseline. Their status is such that there must be a significant improvement in the environmental conditions of the species' respective habitats (over those currently available under the environmental baselines). Any further degradation of the environmental conditions would have a significant impact due to the amount of risk the species presently face under the environmental baselines. In addition, there must be improvements to minimize impacts due to dams, incidental harvest, hatchery practices, and unfavorable estuarine and marine conditions. In this case, the states have proposed to allow an increase in mortality rate in 2005 and argue that the small increase is justified by the recent increase in abundance in winter steelhead populations. How the fisheries are managed after 2005 will depend on further analysis and consideration of the relevant factors.

3.0 EFFECTS OF THE ACTION

3.1 Evaluating the Effects of the Action

3.1.1 Applying ESA section 7(a)(2) standards

Over the course of the last decade and hundreds of ESA section 7 consultations, NMFS developed the following four-step approach for applying the ESA section 7(a)(2) standards when determining what effect a proposed action is likely to have on a given listed species. What follows here is a summary of that approach; for more detail please see *The Habitat Approach: Implementation of Section 7 of the Endangered Species Act for Actions Affecting the Habitat of Pacific Salmonids* (NMFS 1999b).

1. Define the biological requirements and current status of the listed species.

2. Evaluate the relevance of the environmental baseline to the species' current status.

3. Determine the effects of the proposed or continuing action on listed species and their habitat.

4. Determine whether the species can be expected to survive with an adequate potential for recovery under (a) the effects of the proposed (or continuing) action, (b) the effects of the environmental baseline, and (c) any cumulative effects—including all measures being taken to improve salmonid survival and recovery.

Information related to steps one and two is discussed in preceding sections. Information related to steps three and four are is discussed below.

The fourth step above requires a two-part analysis. The first part focuses on the action area and defines the proposed action's effects in terms of the species' biological requirements in that area (i.e., impacts on essential habitat features). The second part focuses on the species itself. It describes the action's impact on individual fish—or populations, or both—and places that impact in the context of the ESU as a whole. Ultimately, the analysis seeks to answer the questions of whether the proposed action is likely to jeopardize a listed species' continued existence or destroy or adversely modify its critical habitat.

3.2 Effects on Habitat

The habitat of the affected ESA listed ESUs in the Columbia River, the essential features of that habitat, and their present condition are described in the 2001 biological opinion (NMFS 2001). The discussion here focuses on how those features are likely to be affected by the proposed actions.

While harvest activities do affect passage in that fish are intercepted, those impacts are accounted for explicitly in the following analyses regarding harvest related mortality. Most of the harvest related activities occur from boats. Gears that are used include primarily drift nets (gillnets and tanglenet), which do not substantially affect the habitat. There will be no disturbance to vegetation, and negligible harm to spawning or rearing habitat, or to water quantity and water quality. Thus, there will be minimal effects on the essential habitat features of the affected species from the actions discussed in this supplemental biological opinion, certainly not enough to contribute to a decline in the values of the habitat.

3.3 Effects on ESA Listed Salmonid ESUs

Fisheries may affect steelhead ESUs in several ways which have bearing on the likelihood of continued survival of the species. Some fish are caught and killed immediately during the course of the fishery. However, this fishery is designed for live capture to allow for the selective release of all steelhead and natural-origin Chinook. Nonetheless, some fish released alive subsequently die. All harvest-related mortality is estimated and accounted for. The proposed 6% mortality rate therefore refers to a total mortality rate for the prescribed fisheries.

The key question to address in the consultation is whether the proposed action, managing the fishery subject to a 6% harvest mortality limit in 2005, is likely to jeopardize the continued existence of the affected ESUs. However, several additional issues came up during the course of the consultation that relate to how the fishery can best be managed to minimize uncertainty and stay within the prescribed mortality limit. Through the consultation, and particularly during the period after the initially proposed 2004 season, the states provided additional information related to:

1) differential run timing of the winter steelhead populations and the potential that populations would be subject to different mortality rates;
2) methods for forecasting run size, both preseason and inseason;
3) the statistical design for monitoring and evaluating fishery mortality rates;
4) what additional impacts may occur to winter steelhead in Tribal fisheries above Bonneville Dam in Zone 6, and;
5) the degree to which summer run steelhead contribute to the catch and thereby reduce the estimated mortality to winter steelhead populations.

Of these, the first question related to differential run timing was most problematic and the subject of considerable scrutiny during the consultation. A key assumption of the management system is that all winter steelhead populations are equally vulnerable to the fisheries so that all would be subject to the same harvest mortality. There is some evidence that certain populations have earlier run timing and would thus be past the mainstem fishing area during the peak of the fishery. If that is true, the remaining populations would be subject to a mortality rate that was potentially significantly higher than the proposed 6% mortality rate limit. Evidence related to the question of differential run timing is discussed in some detail below because it relates directly to whether the fishery can be managed to maintain a low level of impact to all the winter run steelhead populations.

3.3.1 Effects of the Proposed Action

3.3.1.1 Considerations Related to the Proposed Increase in Steelhead Mortality Rate

The states propose to allow for an increase in the mortality rate of winter steelhead from 2% to a maximum of 6% in 2005. Increases in subsequent years will depend on additional proposals provided by the states and NMFS' subsequent review. The states have indicated their intent to refine what they originally proposed for 2004 and 2005 with a management protocol that incorporates a sliding scale impact rate for wild steelhead that is related to measurable variations in marine survival, parental escapement, and perhaps other factors (Lefleur and King 2004). As discussed in the background section at the start of this biological opinion, NMFS takes the states' statement of intent regarding additional work prior to 2006 as a substantive commitment. The current proposal applies only to 2005.

The states also propose to use a 5% mortality rate as a management guideline, meaning that fisheries would be planned for and implemented with the intention that the mortality rate not exceed 5%. The lower management guideline provides a buffer for management uncertainty and reduces the risk of exceeding the 6% cap.

The states argue that the proposed increase in mortality rate is needed to support their harvest objectives which includes a transition to mark-selective fisheries designed to reduce impacts on wild spring Chinook stocks. For spring Chinook the transition to selective fishing has been successful in maintaining harvest opportunity in both the recreational and commercial fisheries with much reduced impacts to wild spring Chinook. For example, inriver harvest rates on listed Upper Willamette spring Chinook have been reduced from 40% - 50% to less than 10% in recent years with less than half the impacts occurring in the commercial fishery. Impacts to listed upriver spring Chinook are limied to a maximum of 2%. However, the transition to a selective fishery that requires the use of small mesh tanglenets has resulted in the increased handle of steelhead. Prior to the switch to tanglenets, impacts to steelhead were quite low because steelhead generally passed through the larger mesh gillnets used to target Chinook salmon. The states articulated that the “need” is motivated by their desire to maintain a fishery that has been redesigned successfully to reduced impacts to wild spring Chinook.

Regardless of the need and related justification, it is still necessary to determine whether the effect of the proposed fishery is or is not likely to jeopardize the affected steelhead ESUs. The states' basic argument is that the abundance of winter steelhead populations has increased significantly in recent years and, as a consequence, can sustain a modest increase in harvest mortality for one year without significant risk to the long-term health of winter steelhead populations. The recent ESA listing review reaffirmed that the status of the affected steelhead ESUs was still depressed and proposed to maintain the listing status of Upper Willamette River, Lower Columbia River, and Middle Columbia River steelhead as threatened (69 FR 33102, June 14, 2004). The Biological Review Team reviewed and documented the record of decline for winter steelhead populations (BRT 2003). As discussed above the environmental baseline for steelhead in these ESUs is generally degraded.

However, it is apparent that the abundance of winter steelhead has increased over the last three to five years. (The BRT reported a decline in abundance over the short-term, but their analysis included returns since 1990. As discussed in section 2.2.1.2, the apparent discrepancy with the states' assertion of recent increases is therefore the result of a focus on different time frames. The distiction is apparent from inspection of Figures 1 and 3) The level of increase varies among populations, but the increase is broad spread and evident for virtually every available winter steelhead population or abundance indicator. On average, abundance is 134% higher in the last four years (2000-2003) compared to the previous four years (1996-1999) for these indicators (from Table 3 and Table 6). It is also pertinent to note that the available data is reasonably comprehensive representing most of the winter steelhead populations in the three ESUs. Abundance data is available for all of the populations in the Upper Willamette River ESU, and 9 of 14 populations in the Lower Columbia River ESU. Most of the larger populatons in the Lower Columbia River ESU are represented by the abundance indicators including 70% of the total potential current habitat in the ESU (from Table 5). There are two winter steelhead populations in the Middle Columbia River ESU. Although information is limited, what is available for Fifteenmile Creek and the Klickitat River also suggests a comparable upward trend in recent years.

Escapement goals are useful as benchmarks for comparison to current estimates of abundance. Different types of escapement goals are available for most of the Lower Columbia River winter steelhead populations. The states have management related escapement goals for several of the populations. These escapement goals presumably relate to some estimate of desired abundance level, but context for these goals is not defined. Two additional abundance goals were identified through the recent subbasin planning process (LCSRB 2004). The higher goal referred to as PFC represents the theoretical capacity if currently accessible habitat was restored to "proper functioning conditions." The "high" escapement goal is consistent with a viable state for the population. Of the ten Lower Columbia River indicator stocks, five have been above one or more of the escapement benchmarks in recent years; some by a substantial margin (Figure 3). Other populations are generally below the specified goals despite increases in recent years.

There are no comparable goals for the Upper Willamette River steelhead populations. However, returns to three of the four Upper Willamette populations (Molalla, North Santiam, and South Santiam) have been 2,000 fish or more in recent years, which is generally greater thean the goals identified for the Lower Columbia River ESU populations, and certainly high enough to mitigate against immediate risks. The smallest system in the ESU is Calapooia, where returns have been several hundred in recent years.

Counts at Willamette Falls are a good index for the total return to the ESU since all returning winter-run steelhead destined to the Upper Willamette River ESU must pass above the Falls. In recent years, returns have been three to four times what they were prior to 2001 (Table 3).

The states' proposal presumes that returns will continue to be higher in 2005 as they have been in recent years. The 2005 forecast for listed winter-run steelhead is 27,000, including 12,000 to the

Upper Willamette River ESU, which is comparable to returns observed in recent years (Table 3) (Kostow 2004).

The states also provide estimates of return per spawner rates for selected populations (figures 2, 4 and 5) which confirm the general point that populations have grown in recent years. Return per spawner rates are therefore generally greater than 1.0 for brood years since 1995 or 1996.

The states also provide estimates of the intrinsic rate of productivity for selected populations (Tables 4 and 7). In all cases the estimates are significantly greater than 1.0 and, with two exceptions, the bounds of the 95% confidence intervals for the estimates are greater than 1.0. The intrinsic rate of productivity is an indicator of a population's ability to grow when reduced to low abundance. The estimates suggest that winter steelhead populations are still reasonably productive despite the reductions in habitat capacity and the generally degraded condition of their habitat.

The direct effect of the proposed mortality rate modification will be to reduce escapement by a maximum of 6% rather than the 2% allowed under the prior fishery management plan. If the expected escapement for a given population is 1000 fish, absent harvest, a 2% mortality rate would result in an escapement of 980 fish; a 6% mortality rate would result in an escapement of 940 fish. Given the general level of increase in abundance observed in recent years and the anticipated return in 2005, NMFS concurs with the states' conclusion that managing the fishery subject to a 6% harvest mortality limit on listed winter-run steelhead in 2005 will have a negligible impact on winter steelhead populations from the affected ESUs. NMFS concludes, based in particular on the above described considerations, that the proposed action will not reduce the abundance in 2005, or otherwise affect the productivity, spatial structure or diversity of the winter-run steelhead populations to a degree that the prospects for survival and recovery of the affected ESUs will be measurably affected.

3.3.1.2 Considerations Related to Differential Timing

As discussed above, NMFS concludes that the proposed increase in mortality rate will have a negligible impact on winter steelhead populations. However, there is a key assumption that winter steelhead populations are equally vulnerable to the fishery impacts. The fishery is managed by predicting the total return of winter steelhead, and then managing the fishery so that the overall mortality rate is less than the specified limit. For a presumed run size of 20,000 and impact limit of 6%, for example, the fishery is managed such that total mortality of steelhead is less than 1,200 fish. There is some evidence to suggest that Upper Willamette River steelhead have an earlier run timing. Upper Willamette River steelhead comprise half or more of the total return of winter steelhead. If Upper Willamette River steelhead have largely moved out of the mainstem fishing areas prior to the fishery, the remaining populations would be subject to a much higher mortality rate. The issue of differential timing is key to the consultation because the outcome affects the fundamental assumption that population specific mortality rates would generally be less than 6%. This is of further concern because it was apparent that abundance increases for the Upper Willamette River populations were stronger than those for the Lower

Columbia River. If Willamette fish really do have earlier timing, it would be the Lower Columbia populations that would be subject to higher mortality rates.

Abundance information collected from tributaries with dams or weirs suggests that run timing varies among winter steelhead in the lower Columbia when run timing is measured in tributaries (LeFleur and Melcher 2004). Oregon tributaries downstream of the Willamette River, such as Scappoose Creek, appear to have very early run times, with peaks in February (Table 11). Scappoose Creek is the western-most Oregon population in the Lower Columbia ESU. Similar run timing occurs at the Big Creek weir further down river (Big Creek is part of the Southwest Washington ESU). The Willamette River is a relatively early run, with a peak run time at Willamette Falls in mid-March (Table 11; Figure 7). However, the Upper Willamette River ESU represents half or more of the aggregate run of winter steelhead. If the Willamette run is early, other populations will be impacted disproportionately by the fishery. The Clackamas River seemingly has a much later run timing, with the peak in early May (Table 11; Figures 6 and 7). Other populations for which data are available have peak run times at their tributary dam or weir in early to mid-April (Table11; Figures 6 and 7).

Table 11. Distance to Traps/Weirs in Selected Tributaries of the Lower Columbia River and average passage dates at these monitoring sites (LeFleur and Melcher 2004).

Tributary	Approximate Distance from Zone 2 (~River Mile 40) (in miles)	Earliest (1) to latest (7)	Average 10% Passage Date	Average 50% Passage Date	Average 90% Passage Date	Percent of Population Passing the Tributary Site during Feb 28-Mar 27 (%)
Kalama	40	5	28-Feb	8-Apr	14-May	25
NF Toutle	55	3	3-Mar	3-Apr	30-Apr	37
Scappoose	60	1	9-Jan	4-Feb	22-Mar	
Willamette	125	2	22-Jan	19-Mar	22-Apr	27
Sandy	150	4	9-Feb	5-Apr	13-May	23
Clackamas	160	7	23-Mar	5-May	25-May	5
Hood	175	6	14-Mar	16-Apr	14-May	13

Direct information on the run timing of populations through the fishery area is not available. However, several lines of related evidence were reviewed including the effects of migration distance and migration conditions, information from past tagging studies on travel timing and holding behavior in the mainstem, and a modeling exercise related to travel speed and distance traveled.

Migration Distance and Conditions: The states argue that much of the apparent discrepancy in run timing between populations can be explained by differences in migration distance and migration conditions (WDFW and ODFW 2004a). All other things being equal, runs with a greater distance to their respective counting stations will seem to have a later run timing. Travel time is also affected by water temperature and river conditions between the fishing area and counting stations. Colder water tends to slow migration. River conditions can impact migration rates with mainstem sections of larger streams functioning as a migration corridor and smaller tributary streams providing holding areas that slow migration. A comparison of the Willamette and Clackamas runs, representing one of the earliest and the latest timed indicators, illustrates the point.

Upper Willamette steelhead are counted at the Willamette Falls fishway located at river mile (RM) 27. The mouth of the Willamette River is approximately 98 miles above the Zone 2 fishing area (Table 11). Once fish enter the Willamette they migrate up a low gradient mainstem section of river with little holding water and few impediments to passage. Water temperatures are also relatively warm which tends to hasten migration up to the fishway.

Fish returning to the Clackamas River are counted at the North Fork Dam. The Clackamas River enters the Willamette River at RM 25 just below Willamette Falls. Fish in the Clackamas travel a greater distance, in a smaller tributary with more holding water, and colder ambient temperatures from the higher elevation drainage. Passage conditions are also more complex. The fish must first pass over a steep and winding fish ladder at River Mill Dam located at RM 23 on the Clackamas. They next encounter the Faraday Powerhouse and the Faraday Diversion Dam located 2 miles further upstream. At Faraday Dam they enter a 1.7 mile long fish way that takes them past both Faraday and the North Fork dams where they are finally counted. The apparent discrepancy in migration timing between the Willamette and Clackamas runs is therefore explicable based on differences in migration distance and conditions.

The Hood River population has the next latest passage timing (Table 11). The mouth of Hood River is 68 miles above the mouth of the Willamette River and 24 miles above Bonneville Dam. The counting station at the Powerdale Project Dam is another 4.5 mile up Hood River. The relatively late timing of the Hood River populations can therefore also be explained, at least in part, based on differences in migration distance and conditions. Although it is not possible to refute the argument that there may be timing differences between the populations, these sorts of qualitative comparisons explain some of the apparent discrepancy and at least diminish the sense that differences in timing may be quite large.

Travel Time and Holding Behavior Through the Columbia River: Direct evidence about travel time and behavior through the mainstem Columbia River is limited, but two studies of winter steelhead movement provide some relevant information.

A cooperative winter steelhead tagging program was conducted by the Oregon and Washington fish management agencies during the winters of 1954-1955 and 1955-1956 (Korn, 1961). One of the major objectives of this study was to "obtain information on the timing of various segments of the run". The study was conducted in the lower Columbia River from the mouth to the upper end of Puget Island at RM 44 and the methods of capture were drift and set gill nets. Fish collection occurred from December 2, 1954 to April 25, 1955 during the first winter and from November 27, 1955 to March 30, 1956 during the second winter. Fish were tagged with spaghetti tags and Petersen disk tags and recovery occurred in subsequent test fishing periods, commercial fishing periods, tributary sport fisheries, fishway traps, and hatcheries.

Results of the study indicated that winter steelhead passed through the lower Columbia River from late November through mid-April with the vast majority of the winter steelhead migration occurring during the month of March. Recovery data was summarized for winter steelhead destined for the Cowlitz, Willamette, Sandy, and Lewis River systems (those with an adequate number of recoveries) with fish being caught and tagged in the mainstem from December through March. The Cowlitz River stock had the most protracted run timing of the stocks but March was the peak month of abundance for all four stocks. The abundance of the Cowlitz stock in the mainstem was similar throughout the January-March timeframe while 40-80% of the Willamette, Sandy, and Lewis River stocks were present in the lower Columbia River during March. Ultimately the study concluded that Willamette was characteristic of lower Columbia River steelhead stocks in that that the bulk of the recoveries were from tagging efforts in March. The Cowlitz River population received a larger portion of the fish tagged in the November-February timeframe. Additionally, the study concluded that winter steelhead remained or milled around in the Columbia River for up to 20 days, and occasionally up to a month, prior to entering the tributaries as evidenced by fish that were tagged and then recaptured in the mainstem fish area. The effect of this milling behavior would be to mask possible run timing differences and diminish the likelihood of significant disproportionate impacts between populations.

The occurrence of peak run timing in March as reported by Korn (1961) is notable and consistent with current observations. In fact, state managers report that peak timing in the mainstem fishery areas occurs over a two week period in mid-March, a time during which they propose to limit fishery openings to minimize impacts to steelhead by avoiding the peak of the run.

The second study related to travel time is based on wild winter steelhead caught and tagged at Bonneville Dam and recovered in Hood River (Rawding unpublished). The distance between the location of tagging and the recapture site was approximately 30 miles. The results indicated that travel time from Bonneville Dam to Hood River was highly variable, with the later fish over Bonneville Dam traveling faster. Travel times ranged from about 20 days up to 120 days. Travel rates ranged from 1.5 miles per day to 0.25 miles per day in the Bonneville Pool. A comparison of the peaks of the run over Bonneville and over Powerdale indicate faster run times at the peak of the run, closer to 2 or 3 miles per day (Figure 8).

The most significant result of Rawding's study was that there was an inverse relationship between the date tagged and travel time to recovery. The later the fish was tagged, the faster the fish traveled from Bonneville Dam to Powerdale Dam ($R^2 = 0.66$) (Figure 8). This sort of behavior is not surprising. It is apparent that winter steelhead enter freshwater over a period of several months. However, the time of spawning for a population must be relative synchronous, with the result that late entrants will have to move more quickly to natal spawning areas. Early comers can dawdle; late comers need to hurry up.

It is also important to note the tagging dates in the Bonneville-to-Powerdale study. Most tagging occurred from early December to mid-March, while the peak of the run over Bonneville Dam appears to be in early April (Figure 9). The fact that the run at Bonneville peaks in early spring suggests that winter steelhead destined to pass Bonneville Dam are likely still in mainstem areas and part of the aggregate of populations moving through the area in mid-March.

Figure 6. Average run timing of the Willamette ESU (measured at Willamette Falls), of the Hood River winter-run population (measured at Powerdale Dam) and of the Clackamas population (measured at North Fork Dam).

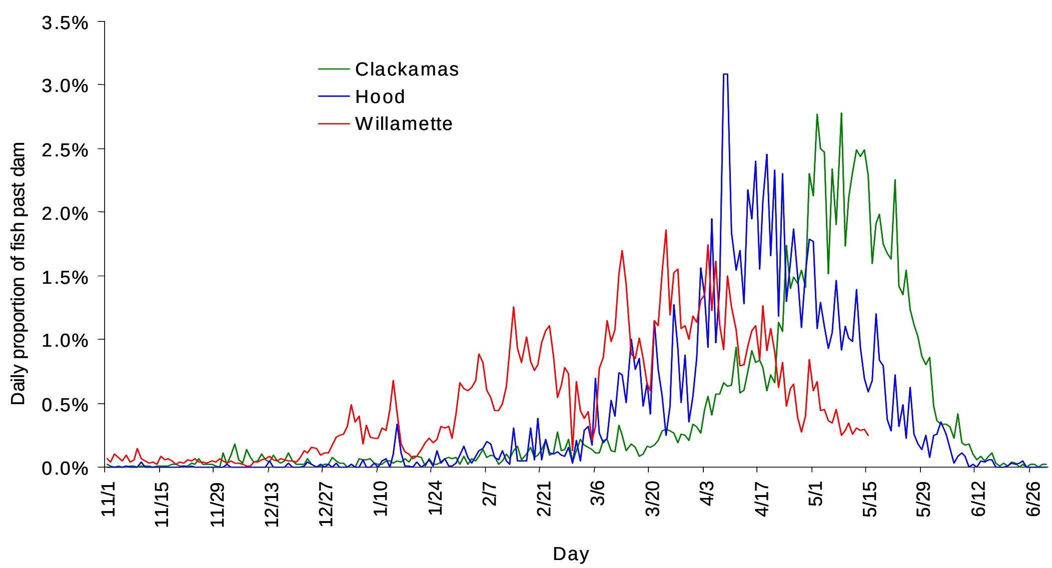


Figure 7. Cumulative passage times into escapement areas in selected tributaries of the Lower Columbia River.

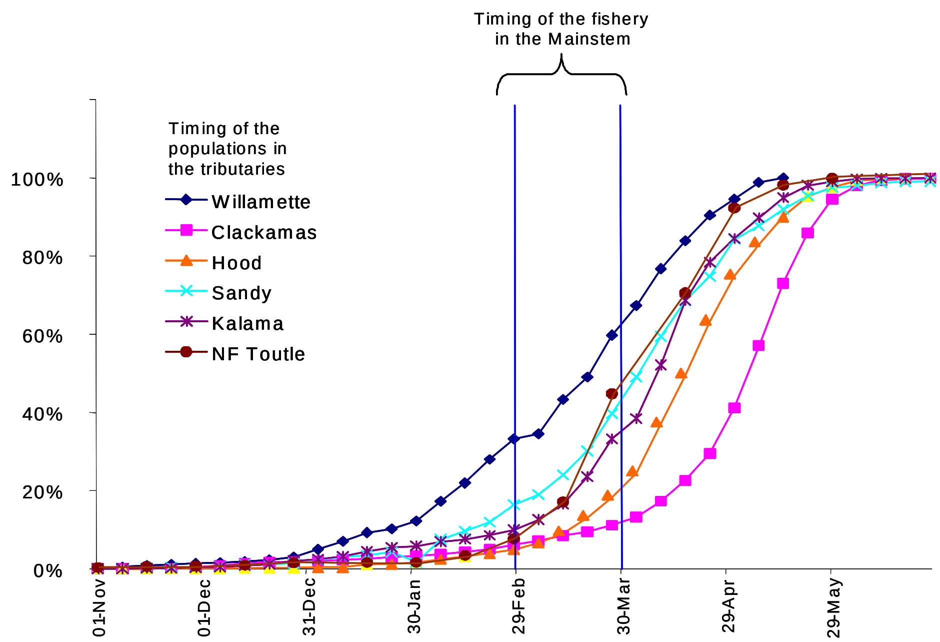


Figure 8. Travel time for wild winter steelhead tagged at Bonneville Dam and recaptured at Powerdale Dam, Hood River. Approximate distance between tagging and recapture locations is 30 miles.

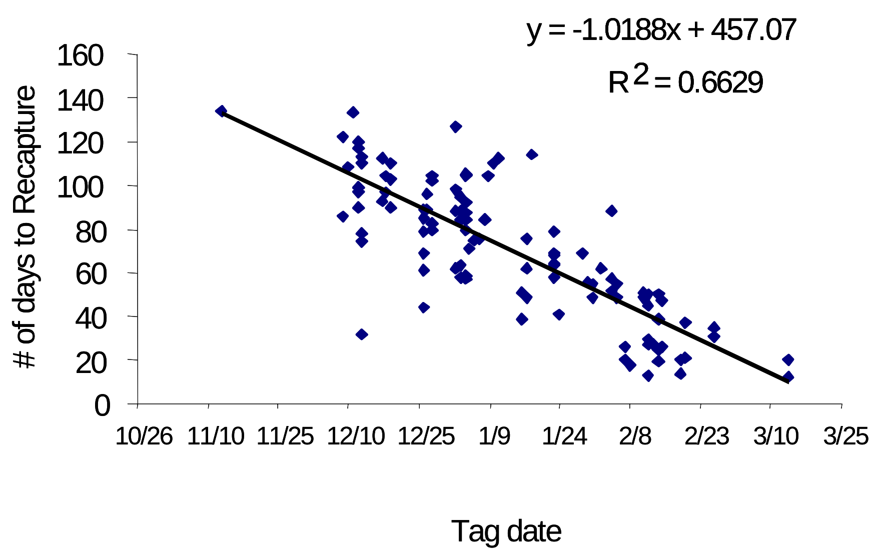
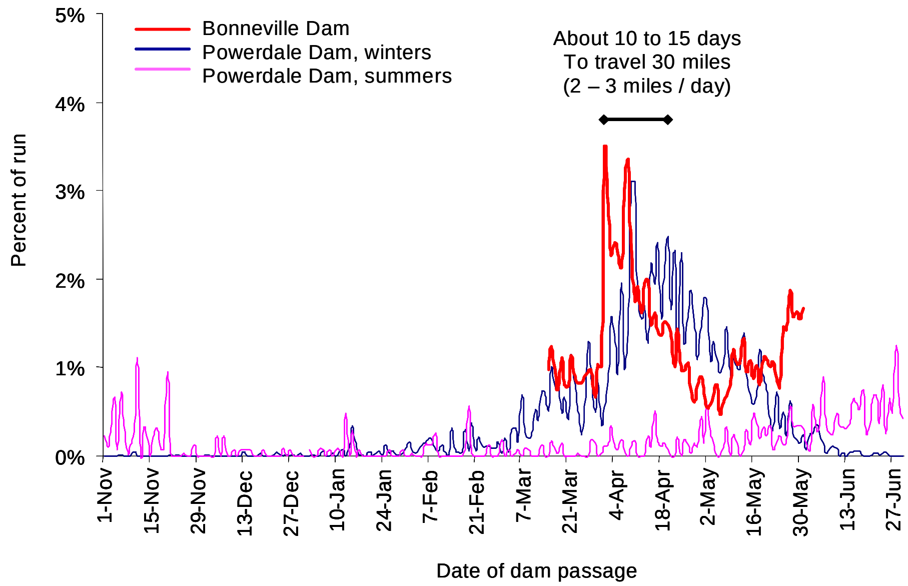


Figure 9. Times of passage at Bonneville Dam and Powerdale Dam. The Hood River fish make up about 30 percent - 40 percent of the fish counted at Bonneville. Plot based on average run time of wild fish for 1993-2003. Counts of winter steelhead prior to March 15 at Bonneville Dam were not available until recently.



Model Relating Distance Traveled and Travel Time: During the consultation, the state work group considered differences in run timing at the weirs and dams in the tributaries, and the timing of the fish in the fishing area. The group estimated the percentage of a given ESU that would be present during the fishery occurring in Zone 2 in the month of March, depending on a range of assumptions regarding travel time (miles per day). The model depends on several simplifying assumptions about how fish traveled through the mainstem.

A model was generated using the following assumptions:

1. The fishery is centered in Zone 2.
2. The migration pattern for each population from river mouth to the counting locations was the same as that observed at the dam or weir where they were counted.
3. An average passage time and an average distance between Zone 2 and the tributary counting station was used for all of the Lower Columbia ESU populations.
4. Fish in the ESUs move at some average rate, and that this rate is the same for all individual fish. A range of average travel time, from 1 to 12 miles per day, was used in the analysis.

Migration timing curves were plotted representing the Willamette and Lower Columbia ESUs. Based on these curves, estimates of the percent of the ESUs that would be present in the Zone 2 fishing area under different assumptions of average travel time were generated (Table 12). Results for three average travel times of 1 mile/day, 2 miles/day, and 5 miles/day are also shown in Figure 10.

The model indicates that if the average travel time was 1 to 3 miles per day, the populations in the Lower Columbia ESU were 2 to 4 times more vulnerable to the Zone 2 fishery than the fish in the Willamette ESU (Table 12). The differences in the proportion of the two ESUs vulnerable during the fishery ranged from 10 percent to 19 percent. The two ESUs were equally vulnerable to the Zone 2 fishery if the travel time was 4 to 8 miles per day, and at faster travel times (8 to 12 miles per day) the vulnerability of the Willamette ESU was slightly higher. At these faster travel times (4 to 12 miles per day) the differences in the proportion of the fish present when the fishery would be occurring between the two ESUs (Willamette and Lower Columbia) ranged from 1 percent to 7 percent. Another implication of the study was that at slow average travel times the vulnerability of both ESUs was lower (less than 15 percent of the populations exposed) compared to the vulnerability of both ESUs at faster average travel times (more than 30 percent of the populations exposed).

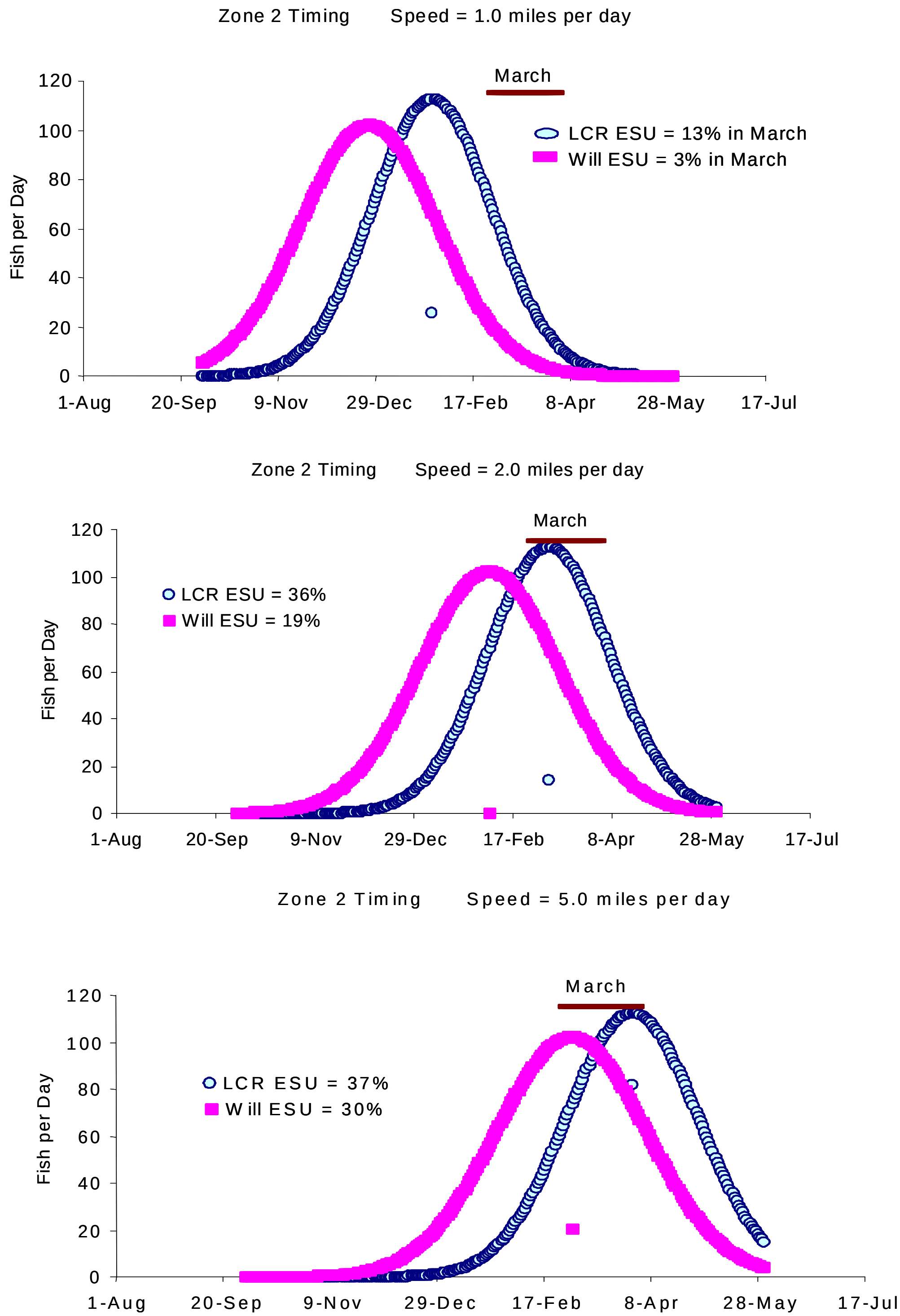
The key assumption of the modeling analysis was that travel time was constant. It is apparent from Rawding’s tagging study at Bonneville that fish move more quickly as the run progresses in time. Rawding’s observations are more consistent with the general observation that steelhead enter the Columbia River over a period of several months. Early in the run, steelhead likely hold or mill about in the mainstem areas as suggested by the Korn study (Korn 1961). As the run progresses, steelhead respond to environmental cues such as changes in water temperature and flow conditions that motivate fish to move more quickly into tributary areas. The modeling analysis, although unrealistic in many respects, suggests that the effect of timing differences, in terms of differential fishery impacts on populations, may still be relatively small. There may well be some differences in run timing between populations, but timing curves are more likely largely overlapping.

Korn (1961) reported in the late 1950's that March was the time of peak abundance in the lower river. Current observations continue to demonstrate a distinct peak in abundance in mid-March. This relatively narrow and distinct peak in timing in the mainsteam is inconsistent with the suggestion that timing between populations is very different, to the degree that some populations would be much more vulnerable to the fishery than others. The fishery is structured with relatively few brief openings spread around the peak of the steelhead run abundance in the mainstem area. With the mortality rate limited to 6% and the fishery managed using a guideline of 5%, it is unlikely that particular populations or run components will be subject to significant disproportionate impacts. More informaton is clearly needed related to migration timing, but NMFS concurs that it is reasonable to assume, based on available information and the structure of the fishery, that winter steelhead populations are not likely to be subject to significant differences in harvest mortality as a result of the proposed fishery.

Table 12. Modeled percent of the Lower Columbia ESU and Willamette ESU that are Present in the Area of the Zone 2 Fishery Under Different Assumptions of Travel Time.

(miles/day)	Percent of Population in Zone 2 During March		
Assumed travel time (miles/day)	Lower Columbia ESU	Willamette ESU	Difference
1	13	3	10
1.5	31	12	19
2	36	19	7
3	38	27	11
4	37	30	7
5	37	30	7
6	34	32	2
8	32	33	1
10	31	33	2
12	30	34	4

Figure 10. A Model of Relative Run Timing in the Zone 2 Fishery (March). The timing for the Willamette ESU and for an average of the Lower Columbia ESU are shown under four different travel times.



4.0 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local or private actions not involving Federal activities that are reasonably certain to occur within the action area subject to this consultation. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act.
State, Tribal and local government actions will likely to be in the form of legislation, administrative rules or policy initiatives. Government and private actions may include changes in land and water uses, including ownership and intensity, any of which could impact listed species or their habitat. Government actions are subject to political, legislative and fiscal uncertainties. These realities, added to the geographic scope of the action area which encompasses numerous government entities exercising various authorities and the many private land holdings, make any analysis of cumulative effects difficult and speculative. This sections identifies representative actions that, based on currently available information, are reasonably certain to occur. It also identifies some goals, objectives and proposed plans by government entities, however, NMFS is unable to determine at this time whether any proposals will result in specific actions.

4.1 Representative State Actions

Each state in the Columbia River basin administers the allocation of water resources within its borders. Most streams in the basin are over–appropriated even though water resource development has slowed in recent years. Washington closed the mainstem Columbia River to new water withdrawals, and is funding a program to lease or buy water rights. If carried out over the long term this might improve water quantity. State and local governments are cooperating with each other and Federal agencies to increase environmental protections, including better habitat restoration , hatchery and harvest reforms. NMFS also cooperates with the state water resource management agencies in assessing water resource needs in the Columbia River basin, and in developing flow requirements that will benefit listed fish. During years of low water, however, there could be insufficient flow to meet the needs of the fish. These government efforts could be discontinued or even reduced, so their cumulative effects on listed fish is unpredictable. Most future actions in Oregon are described in the Oregon Plan for Salmon and Watershed (OPSW).

Along with significant harvest and hatchery measures, the OPSW includes the following habitat-related programs designed to benefit salmon and watershed health:

- Oregon Department of Agriculture Water Quality Management plans
- Oregon Department of Environmental Quality Total Maximum Daily (pollutant) Loads (TMDLs) in targeted basins.
- Oregon Watershed Enhancement Board funding programs for watershed enhancement programs, land and water acquisitions.
- ODFW and Oregon Water Resources Department programs to enhance flow restoration.

If these programs are actually implemented, there may be some improvement in various habitat features considered important for the listed species. The Oregon Plan also identifies several private and public cooperative programs for improving the environment for listed species. The success of such programs will depend on continued interest and cooperation among the parties involved.

The state of Washington has various strategies and programs designed to improve the habitat for listed species and assist in recovery planning. One such is the Salmon Recovery Planning Act—a framework for developing watershed restoration projects. The state is also developing a water quality improvement scheme through the development of TMDLs. As with the Oregon initiatives, these programs could benefit the listed species if implemented and sustained.
The Washington state government is cooperating with other governments to increase environmental protection for listed ESUs, including better habitat restoration, hatchery and harvest reforms, and water resource management. The following is a list of many of Washington's major efforts to protect and restore salmonids and their habitat:

- Washington Wildlife and Recreation Program
- Wild Stock Restoration Initiative
- Joint Wild Salmonid Policy
- Governor's Salmon Recovery Office
- Conservation Commission
- Salmon Recovery Lead Entities
- Salmon Recovery Funding Board

In the past, each state's economy was heavily dependent on natural resources, with intense resource extraction activity. Changes in the states' economies have occurred in the last decade and are likely to continue with less large scale resource extraction, more targeted extraction methods, and significant growth in other economic sectors. Growth in new businesses is creating urbanization pressures with increased demands for buildable land, electricity, water supplies, waste disposal sites and other infrastructure.

Economic diversification has contributed to population growth and movement in the states, a trend likely to continue for the next few decades. Such population trends will place greater demands in the action area for electricity, water and buildable land; affect water quality directly and indirectly; and increase the need for transportation, communication and other infrastructure development. The impacts associated with economic and population demands will affect habitat features, such as water quality and quantity, which are important to the survival and recovery of the listed species. The overall effect is likely to be negative, unless carefully planned for and mitigated.

Some of the state programs described above are designed to address these impacts. Oregon has a statewide land use planning program with growth management and natural resource protection goals. Washington enacted a Growth Management Act to help communities plan for growth and address growth impacts on the natural environment. If the programs continue they may help lessen some of the potential adverse effects identified above.

4.2 Local Actions

Local governments will be faced with similar but more direct pressures from population growth and movement. There will be demands for intensified development in rural areas as well as increased demands for water, municipal infrastructure and other resources. The reaction of local governments to such pressures is difficult to assess at this time without certainty in policy and funding. In the past local governments in the action area generally accommodated additional growth in ways that adversely affected listed fish habitat. Also, there is little consistency among local governments in dealing with land use and environmental issues so that any positive effects from local government actions on listed species and their habitat are likely to be scattered throughout the action area.

In both Oregon and Washington local governments are considering ordinances to address aquatic and fish habitat health impacts from different land uses. These programs are part of state planning structures; however, local governments in Oregon are likely to be cautious about implementing new programs because of the passage of a takings constitutional amendment. Some local government programs, if submitted, may qualify for a limit under the NMFS' ESA section 4(d) rule which is designed to conserve listed species. Local governments also may participate in regional watershed health programs, although political will and funding will determine participation and therefore the effect of such actions on listed species. Overall, without comprehensive and cohesive beneficial programs and the sustained application of such programs, it is likely that local actions will not have measurable positive effects on listed species and their habitat, but may even contribute to further degradation.

4.3 Tribal Actions

Tribal governments will continue to participate in cooperative efforts involving watershed and basin planning designed to improve fish habitat. The results from changes in Tribal forest and agriculture practices, in water resource allocations, and in changes to land uses are difficult to assess for the same reasons discussed under State and Local Actions. The earlier discussions related to growth impacts apply also to Tribal government actions. Tribal governments will need to apply comprehensive and beneficial natural resource programs to areas under their jurisdiction to produce measurable positive effects for listed species and their habitat.

4.4 Private Actions

The effects of private actions are the most uncertain. Private landowners may convert current use of their lands, or they may intensify or diminish current uses. Individual landowners may voluntarily initiate actions to improve environmental conditions, or they may abandon or resist any improvement efforts. Their actions may be compelled by new laws, or may result from population growth and economic pressures. Changes in ownership patterns will have unknown impacts. Whether any of these private actions will occur is highly unpredictable, and the effects even more so.

4.5 Summary

Non-federal actions are likely to continue affecting the listed species. The cumulative effects in the action area are difficult to analyze considering the large geographic scope of this opinion, the political variation in the action area, the uncertainties associated with government and private actions, and the changing economies of the region. Whether these effects will increase or decrease is a matter of speculation; however, based on the trends identified in this section, the adverse cumulative effects are likely to increase. Although state, Tribal and local governments have developed plans and initiatives to benefit listed fish, they must be applied and sustained in a comprehensive way before NMFS can consider them “reasonably foreseeable” in its analysis of cumulative effects.

5.0 INTEGRATION AND SYNTHESIS OF EFFECTS

Through this reinitiated consultation, NMFS has again reviewed information related to the biological requirements, status, and environmental baseline for winter steelhead populations of the Upper Willamette River, Lower Columbia River, and Middle Columbia River steelhead ESUs. It is apparent that steelhead from these ESUs have gone through a long period of decline to the point where their listing under the ESA was warranted. The states proposed to increase the allowable harvest mortality rate on the winter steelhead populations from these ESUs from 2% to a maximum of 6% in 2005. The proposed increase is related the states’ desire to continue with implementation and development of a selective tanglenet fishery directed at unlisted, hatchery-origin spring Chinook. The transition to a selective fishing technology has allowed the states to maintain a fishery with very low impacts to wild spring Chinook (on the order of a few percent). A consequence of using the small mesh tanglenets that allows for live capture and release, is that more steelhead are now handled in the fishery. Steelhead are thus a potential constraint to the Chinook fishery.

The states base their proposed increase in harvest mortality largely on the proposition that the status of winter steelhead has improved significantly over the last three to five years, and given their improved status, that the proposed increase will have a negligible impact on winter steelhead populations. Based on our review of the available information, NMFS concurs that winter steelhead populations have increased substantially over the last few years (by an average of 134% over the last four years), and that the increase as been comprehensive including most populations in the affected ESUs (see section 3.3.1 for more details). Available information suggests that returns will continue to be strong in 2005. Given the observed increase in abundance and productivity, NMFS concludes that managing the fishery subject to a 6% harvest mortality limit in 2005 will not reduce the abundance or other critical life history parameters to a degree that the prospects for future survival and recovery of the affected populations will be measurably affected.

NMFS also considered information related to possible differential run timing between populations. Differential timing was potentially significant because of the key assumption that all winter steelhead populations are equally vulnerable to the fishery impacts. If there are significant run timing differences, some populations may be subject to higher harvest mortality during the fishery than others. After reviewing the available information, NMFS concluded that it is unlikely that particular populations or run components will be subject to significant disproportionate impacts. More information is clearly needed related to migration timing, but NMFS concurs that it is reasonable to assume, based on available information and the structure of the fishery, that winter steelhead populations are not likely to be subject to significant differences in harvest mortality as a result of the proposed fishery.

6.0 CONCLUSION

The proposal considered in this consultation is to manage the winter, spring, and summer season fisheries in the Columbia River subject to a 6% harvest mortality limit on listed winter-run steelhead. But conclusions related to jeopardy for a proposed action pertain to the ESUs and not a subset of the populations. Two of the three ESUs considered in this consultation also include summer run populations. Upper Willamette River steelhead all have winter run timing. The Lower Columbia River ESU is composed primarily of winter run populations (fourteen of twenty extant populations have winter-run timing). Only two of the Middle Columbia River populations have winter run timing. The status and other information related to the summer run populations from these ESUs were not reviewed in this consultation since the states' proposal would not change the level of impact considered in the 2001 opinion or 2003 supplemental opinion. Populations with summer run timing will still be subject to a 2% harvest mortality limit. The focus of the analysis is on winter steelhead; the conclusion pertains to the affected ESUs.

After reviewing the current status of the listed ESUs considered in this opinion, the environmental baseline for the action area, the effects of the proposed increase in incidental take of listed winter steelhead populations, and cumulative effects, and similar considerations related to summer run populations in the prior consultation (NMFS 2003), it is NMFS' biological opinion that the non-treaty fishery managed as proposed subject to a 6% harvest mortality limit for listed winter steelhead populations is not likely to jeopardize the continued existence of the Upper Willamette River, Lower Columbia River, or Middle Columbia River steelhead ESUs.

The essential habitat features for the three ESUs considered in this biological opinion are not substantially affected by the proposed fisheries. The proposed fisheries will therefore not result in the destruction or adverse modification of any of the essential habitat features for Upper Willamette River, Lower Columbia River, or Middle Columbia River steelhead.

7.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. Harass is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The measures described below are non-discretionary; they must be undertaken by the action agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The action agencies have a continuing duty to regulate the activity covered in this incidental take statement. If the action agencies (1) fail to assume and implement the terms and conditions or (2) fail to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the agencies must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

The ITS from the 2001 biological opinion was modified where necessary during the 2003 consultation, but was otherwise incorporated in its entirety in the 2003 supplemental biological opinion to provide a complete record of the applicable provisions. Provisions related to the incidental take of winter steelhead in the ITS have been modified as a result of this consultation. Those modifications are incorporated here. The full text of the ITS is modified where necessary, and again incorporated here to provide a complete record of the amount and extent of expect take, reasonable and prudent measures, and terms and conditions that apply to the winter, spring, and summer season fisheries in 2005.

7.1 Amount or Extent of the Take

The amount or extent of the take described in the 2001 and 2003 opinions (NMFS 2001, 2003) remains unchanged with the exception of provisions related to take of Upper Willamette River, Lower Columbia River, and Middle Columbia River steelhead ESUs in nontreaty fisheries. NMFS anticipates that listed species will be taken as a result of winter, spring, and summer season fisheries managed in 2005 by the terms of the Interim Agreement. The incidental take is expected to be in the form of catch and retention, or mortalities resulting from catch and release, or mortalities resulting from encounter with fishing gear, as a consequence of fishery activities. The amount of take is described in terms of a mortality rate or the percent of the run taken by the combined treaty Indian and non-Indian fisheries.

UCR spring Chinook and Snake River spring/summer Chinook salmon and winter steelhead are expected to be the primary management constraints, in most years, for the mainstem fisheries in that they will define the upper limit of allowable harvest. For Upper Columbia River spring Chinook and Snake River spring/summer Chinook, NMFS expects that the fisheries will be managed conservatively, but up to the specified limit of allowable harvest. In analyzing the anticipated effects for the other ESUs, NMFS considered both the outside limit of anticipated mortality rate (the maximum) and the expected harvest rates based on averages from recent years (NMFS 2001, Table 14). For these ESUs, NMFS continues to use the maximum recent years' harvest rates to define the upper limit of estimated take in the ITS even though it is unlikely that the resulting harvest rates will be that high. More likely, the actual harvest rate will vary around the average, and therefore be somewhat lower on the whole than the level estimated. NMFS' analysis in the 2001 biological opinion and subsequent supplements is based on the upper level of estimated take.

The total harvest rate limit for natural-origin UCR spring Chinook salmon ESU and the spring component of the Snake River spring/summer Chinook salmon ESU in non-Indian and treaty Indian fisheries is defined by the harvest rate schedule shown in Table 13 of the 2001 Opinion (NMFS 2001). Allowable harvest rates will be determined, both annually and inseason, depending on the applicable run sizes.

For all of the remaining ESUs, the harvest rate limits for the treaty Indian fisheries are the maximums shown under the Treaty Indian Fisheries column in Table 14 of the 2001 Opinion (NMFS 2001). No take of spring Chinook from the Lower Columbia River Chinook salmon ESU is anticipated. The harvest rate on the summer component of the Snake River spring/summer Chinook salmon ESU and Upper Willamette River spring Chinook salmon ESU will not exceed 5% and 0.5%, respectively. The harvest rate limit for Snake River sockeye salmon in the tribal fisheries is 7%. Harvest rates for Lower Columbia River steelhead, Middle Columbia River steelhead, and Snake River Basin steelhead ESUs will not exceed 4.9%, 7.7%, and 5.7%, respectively. No take of Upper Willamette River steelhead is expected. The harvest rate limits for Upper Columbia River hatchery and natural-origin steelhead are 5.6% and 7.6%, respectively.

Except for Upper Columbia River spring Chinook and Snake River spring Chinook salmon, the harvest rate limits for the state fisheries are also summarized in Table 14 of the 2001 Opinion (NMFS 2001). Harvest rates in the proposed state fisheries for Lower Columbia River spring Chinook will not exceed 12%. The harvest rate limits for Snake River summer Chinook and sockeye salmon are both 1%. Harvest rates for natural-origin summer run steelhead from the Lower Columbia River, Upper Willamette River, Middle Columbia River, Upper Columbia River, and Snake River Basin ESUs may not exceed 2%. The harvest rate limit for Upper Columbia River hatchery-origin steelhead is 6%. The harvest rate limit for the aggregate of winter-run populations returning to Lower Columbia River, Upper Willamette River, and Middle Columbia River steelhead ESUs is 6%.

The expected impacts are based on the pre-season run size projection, provided for each run by the TAC. The TAC will update the runsize projections inseason each year as information from fisheries and dam counts becomes available. The actual number of listed fish which can be incidentally harvested will change accordingly each year. It is the applicable harvest rate limits, and not a static number of listed fish, that defines the limit of mortality in these fisheries. A post-season report, based on catch and the observed run size, will also be provided by TAC. Inseason monitoring will occur to ensure that fishery-specific impacts, applied to inseason updates of the run-size projection whenever possible, do not deviate substantially from expectation.

During this consultation, NMFS also considered the mortality that may occur associated with research, monitoring, and evaluation activities that are designed to minimize incidental take resulting from implementation of selective fisheries. Mortality associated with the research and monitoring activities planned in 2005 is not expected to exceed a rate of 0.2% of natural-origin UCR or Snake River spring Chinook salmon, in particular, or other listed ESUs in general.

The research, monitoring, and evaluation program initiated in 2001 related to selective fishery implementation was intended to be a multi-year effort. Aspects of the program are expected to continue in 2005 and beyond. Mortality associated with the program will be kept to a minimum, but, in order to provide an upper limit of impacts, NMFS estimates that take will not exceed an annual rate of 0.5% of any natural-origin component of a listed ESU.

7.2 Reasonable and Prudent Measures

NMFS believes that the reasonable and prudent measure(s) described in the 2001 ITS and as modified in 2003 are necessary and appropriate to minimizing take of Columbia River Basin listed salmonids, and therefore remain in effect for this supplemental biological opinion. The reasonable and prudent measures have been updated as necessary, but not modified in substance as a result of the 2005 consultation.

It is essential that inseason management measures taken during the course of the fisheries be consistent with the Agreement (U.S. v Oregon parties 2001). In order to implement these measures, it is necessary to monitor both run size and catch during the season. Information on stock composition is necessary to assess impacts on listed fish, and provide timely indications of changes in the assumptions about species proportions, conversion rates, and age compositions used to develop these harvest objectives. To assure conformity with the specified harvest rates and to provide information necessary for monitoring stock utilization and performance, the following reasonable and prudent measures are established.

1. ODFW and WDFW shall manage the commercial spring Chinook fishery to minimize harvest impacts on listed salmonids.

2. Parties to the Interim Agreement shall provide preseason information necessary to manage the commercial spring Chinook fishery as proposed. This information includes preseason runsize estimate for natural-origin winter steelhead and catch-and-release long-term mortality for spring Chinook and steelhead associated with the gear used in the non-Indian commercial spring Chinook fishery.

3. Parties to the Interim Agreement shall monitor salmonid passage at Columbia River dams, and TAC shall provide updates to run size projections.

4. ODFW and WDFW shall monitor the catch for all Zone 1-5 commercial and recreational fisheries, and Zone 6 commercial fisheries.

5. Parties to the Interim Agreement shall implement a research, monitoring, and evaluation program to further develop selective fishery strategies to reduce impacts on listed fish and provide alternative harvest opportunities. Results from all research, monitoring, and evaluation work done in conjunction with the development and assessment of selective fisheries shall be reported to NMFS by the management agency conducting the activity.

7.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the action agencies must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1a. ODFW and WDFW shall manage their commercial spring Chinook fishery to keep harvest rates within the above described limits, based on TAC's preseason projections of run size and any subsequent inseason updates.

1b. The non-Indian commercial spring Chinook tangle-net selective fishery shall be managed using a harvest rate cap for winter steelhead that is less than 6% to allow for anticipated recreational fishery impacts and provide a buffer for management uncertainty.

1c. Large mesh nets (9-inch minimum mesh) may be used to minimize the encounter rate for steelhead. Alternatively, tangle nets with a maximum mesh size of 4 1/4-inch mesh shall be used to minimize the mortality rate associated with steelhead encounters. Voluntary use of steelhead excluders by the commercial fishers shall be encouraged.

1d. In 2003, TAC recommended using a 35% long-term mortality rate for 8-inch mesh and a 20% rate for the 4 1/4 inch mesh for winter steelhead in the non-Indian commercial spring Chinook tangle-net selective fishery. TAC shall review 2003 long-term survival study results and other available information to modify the mortality estimates if necessary for use in 2005 and beyond.

1e. Use of recovery boxes, short soak times, and reduced net length are mandatory.

2a. The parties to the Interim Agreement are responsible for providing preseason forecasts of run size necessary to manage the commercial spring Chinook fishery as proposed. These shall be provided annually to NMFS by the TAC by December 15 of each year, for fisheries starting on January 1st the following year.

2b. ODFW and WDFW shall also provide to NMFS annually a Table equivalent to Table 14 in this opinion that reports the expected total mortality rates in state fisheries for each listed ESU. The Table shall be provided to NMFS by December 15 of each year and will be used by NMFS to assess continued compliance with the proposed action.

3a. Parties to the Interim Agreement shall monitor dam counts and other available information to develop inseason updates to run size estimates for Upriver spring Chinook salmon. All revisions to preseason information shall be report to NMFS by TAC as they become available. The inseason information is necessary to ensure continued compliance with the proposed action.

3b. Maximum allowable mortality rates used to plan fisheries shall be based on a percentage of this preseason runsize estimate as applicable

3c. In 2005, estimates of impacts on wild winter steelhead in the non-Indian commercial spring Chinook tangle-net selective fishery are based on the preseason run size information, the assumption that 5%-25% of the steelhead caught are summer-run fish, and that 3.5% of the unmarked steelhead are hatchery-origin fish. Summer steelhead are assumed to range from 5% of the catch in February to 25% of the catch in late March. These estimates may be updated based on new information, but similar procedures shall be used for estimating harvest impacts.

4a. Monitoring of catch in all Zone 1-5 fisheries by ODFW and WDFW shall be sufficient to provide statistically valid estimates of the salmonid catch. Sampling of the commercial catch shall include daily contact with buyers regarding the catch of the previous day. The recreational fishery shall be sampled using effort surveys and suitable measures of catch rate. Monitoring of commercial catch in the Zone 6 fisheries by ODFW and WDFW shall be sufficient to provide statistically-valid estimates of the salmonid catch. The monitors shall be on-board the commercial boats and collect a variety of data, including numbers of steelhead and spring Chinook handled, mark rate, condition at capture, and condition at release.

4b. Results from the catch monitoring shall be reported to NMFS by TAC periodically as necessary to ensure that the catch remains within the prescribed harvest rate limits. Periodically may mean weekly or more often during active fishing periods. Data are summarized the day following each fishing period and reported to the fishery managers and the TAC.

4c. The TAC shall account for the catch of each fishery as it occurs through the season. If it becomes apparent inseason that any of the established harvest rate limits may be exceeded due to catch or revisions in the run-size projection, then the states and tribes shall take additional management measures to reduce the anticipated catch as needed to conform to the limits.

4d. In 2003, WDFW continued to study the long-term mortality rate for spring Chinook as well as investigating long-term mortality rates for steelhead. These data and the results of subsequent studies shall be analyzed and used for managing fisheries in 2005 and beyond.

5a. ODFW, WDFW, and the treaty tribes shall ensure that shad experimental fisheries are devised in ways such that indirect effects not accounted for in the harvest rate ceilings, such as passage delay, are negligible. Treaty and non-treaty shad fisheries shall be adequately monitored to account for all salmonid impacts. Before fisheries take place in or near dam passage facilities, a proposal for each fishery shall be coordinated through NMFS, the U.S. Army Corps of Engineers (USACE), and the Fish Passage Advisory Committee (FPAC). Nets used in shad fisheries shall not occlude more than the top half of the water column, nor shall they substantially obstruct any exit from adult fish passage routes. No shad fishery shall occur within any operating adult salmon fishway.

5b. Monitoring of shad fisheries shall be sufficient to detect, on a timely basis, the impedance of adult salmonid passage. Methods to evaluate such impedance require development, but may include information from radio-tagging studies, dam counts, or other direct observations. Descriptions of proposed shad fisheries shall include specific adult passage delay evaluation methods. If noticeable passage delay occurs as a result of experimental shad fisheries, those fisheries shall be suspended, or altered in such a way as to eliminate passage delay. Such fishery alterations shall also be reviewed by NMFS, the USACE, and the FPAC.

6. The development and implementation of selective fishing methods provides a means to further minimize the incidental take of listed fish. Research, monitoring,

and evaluation activities are necessary to develop and assess new selective fishing techniques. The activities also are needed to determine how the gear can be used to maximize catch and minimize the associated incidental mortality of released fish. A further objective is to measure the associate handling mortality so that the effects of using the gear can be correctly assessed. To be useful, the information gathered must be reported and synthesized in an organized manner. The results from all such activities shall therefore be reported to NMFS by TAC which will serve a reporting and coordination function in this regard. The state, tribe, or other entity responsible for each assessment activity shall provide an initial summary of its results to TAC and NMFS within one month of the completion of the associated field work. TAC shall then provide to NMFS an annual summary of the results from all related projects by October 31 of each year.

NMFS believes that incidental take resulting from the proposed fisheries will be no greater than that described in section 8.1, above. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, or impacts are incurred disproportionately on any component of the aggregate return in a manner not considered here, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided, as described in section 10.0, below. In such a case, the agencies must immediately provide an explanation of the causes of the excess taking, and review with the NMFS the need for possible modification of the reasonable and prudent measures.

8.0 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop additional information. The following conservation recommendations are consistent with the above described obligations, and therefore should be implemented:

1. It would be useful to have a method for updating the expected return of natural-origin spring Chinook and steelhead inseason so that harvest can be more responsive to the strength of the run. NMFS therefore recommends that TAC explore the options for developing such a method.

2. There continues to be some uncertainty about impacts to winter steelhead resulting from implementation of the modified harvest mortality limit in 2005. Prior the the 2006 season, the states of Oregon and Washington should further analyze and describe the status of winter run populations and conduct a risk assessment that relates population size to varying levels of harvest

mortality. This should include a consideration of the effects on weak stocks among the aggregate of winter run populations.

3. Prior to the 2006 season the states of Oregon and Washington should investigate the use of a sliding scale harvest rate schedule related to stock abundance and indicators of marine survival.

4. The assumption that winter run steelhead populations have similar run timing and are thus subject to similar mortality rates as a result of the fishery remains key. Additional information or research related to run timing should be considered prior the 2006 fishery.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

9.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the additional management guidelines proposed to be incorporated into the Agreement. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take specified in the Incidental Take Statement is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect on to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, section 7 consultation must be immediately reinitiated.

10.0 MAGNUSON-STEVENS ACT ESSENTIAL FISH HABITAT CONSULTATION

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));
- NMFS must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A));
- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the

activity on EFH. In the case of a response that is inconsistent with NMFS EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

An EFH consultation was conducted and is included in the 2003 biological opinion. An action agency must reinitiate the EFH consultation if plans for these actions are substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for the EFH conservation recommendations (50 CFR Section 600.920(k)). EFH is not designated for the listed steelhead ESUs, but was designated for the Chinook salmon ESUs considered in the 2003 biological opinion. However, provisions related to the management of Chinook salmon have not changed as a result of this reinitiated consultation and no additional affects to designated EFH are anticipated. The EFH consultation inlcuded in the 2003 biological opinion was therefore not reinitiated.

11.0 REFERENCES

Allen, J., A. Salamack, P. Schoonmaker. 1999. Restoring the Willamette Basin: Issues and challenges. Institute for the Northwest.

Benner, P. A., and J. R. Sedell. 1997. Upper Willamette River landscape: a historical perspective. Pages 23-47 In A. Laenen and D.A. Dunnette (editors) River Quality B Dynamics and Restoration. Lewis Publishers, New York, New York.

Bevan, D., J. Harville, P. Bergman, T. Bjornn, J. Crutchfield, P. Klingeman, J. Litchfield. 1994. Snake River Salmon Recovery Team: Final recommendations to National Marine Fisheries Service. May 1994.

BRT (Biological Review Team). 2003. Updates Status of Federal Listed ESUs of West Coast Salmon and Steelhead. West Coast Salmon Biological Review Team. July 2003.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-27. 261p.

Chilcote, M.. 1997. Conservation status of steelhead in Oregon. Oregon Department of Fish and Wildlife, Portland.

Chilcote, M.W. 1998. Conservation status of steelhead in Oregon. Information report number 98-3. Fish Division. Portland, Oregon.

Collis, K., S. Adamany, D. D. Roby, D. P. Craig, and D. E. Lyons. 1999. Avian predation on juvenile salmonids in the lower Columbia River. Report to Bonneville Power Administration and U.S. Army Corps of Engineers. Columbia River Inter-Tribal Fish Commission, Portland, Oregon, and Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Corvallis. October.

CBFWA (Columbia Basin Fish and Wildlife Authority). 1990. Review of the History, Development, and Management of Anadromous Fish Production Facilities in the Columbia River Basin. 52 p. Available Columbia Basin Fish and Wildlife Authority, 2501 S.W. First Avenue, Suite 200, Portland, Oregon 97201.

Cooper, R., and T. H. Johnson. 1992. Trends in steelhead (*Oncorhynchus mykiss*) abundance in Washington and along the Pacific coast of North America. Washington Department of Wildlife, Fisheries Management Division. 90pp.

Doppelt, B., M. Scurlock, C. Frissell, and J. Karr. 1993. Entering the watershed: a new approach to save America's river ecosystems. Island Press, Washington, D.C. 200014-10

Federal Caucus. 2000. Conservation of Columbia River Fish: Final Basinwide Salmon Recovery strategy. December. http://www.samonrecovery.gov

Flagg, T. A., F. W. Waknitz, D. J. Maynard, G. B. Milner, and C.V.W. Mahnken. 1995. The effect of hatcheries on native coho salmon populations in the lower Columbia River. *In* Uses and effects of cultured fishes in aquatic systems. Transactions of the American Fisheries Society 15:366-375.

Francis, R.C. and S.R. Hare. 1997. Regime scale climate forcing of salmon populations in the Northeast Pacific - some new thoughts and findings. [In] Emmett, R.L. and M.H.Schiewe [eds]. 1997. Estuarine and ocean survival of Northeastern Pacific salmon: Proceedings of the workshop. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-29, pp. 113-128.

Frissell, C. A. 1993. A new strategy for watershed restoration and recovery of Pacific salmon in the Pacific Northwest. Prepared for Pacific Rivers Council, Eugene, Oregon.

Henjum, M. G., J. R. Karr, D. L. Bottom, D. A. Peery, J. C. Bednarz, S. G. Wright, S. A. Beckwitt, and E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries, and watersheds: national forests east of the Cascade Crest, Oregon, and Washington. The Wildlife Society, Bethesda, Maryland.

Hulse, David. ed. (1998) Willamette River Basin: A Planning Atlas. Institute for a Sustainable Environment, Eugene, Oregon.

ISG (Independent Science Group). 1996. Return to the river: restoration of salmonid fishes in the Columbia River ecosystem. ISG, Report 96-6, for Northwest Power Planning Council, Portland, Oregon.

Korn, L. August 1961. A Winter Steelhead Tagging Program on the Columbia River. Contribution Number 26. Fish Commission of Oregon. Portland, Oregon. 35 pps.

Kostow, K. 2004. Memorandum to U.S. v Oregon Technical Advisory Committee. 2005 Lower Columbia Winter Steelhead Forecast, Oregon Tributaries. December 17, 2004.

LCFRB (2004). Lower Columbia River Fish Recovery Board. 2004. Lower Columbia River Salmon Recovery and Fish and Wildlife Subbasin plan. LCFRB. Kelso, WA.

Lower Columbia River Estuary Program. 1999. Comprehensive Conservation and Management Plan. Volume 1: June 1999. Lower Columbia River Estuary Program, Portland, Oregon.

LeFleur, C. 2003. Letter to P. Dygert, NMFS. February 19, 2003. 3p.

LeFleur, C., and S. King. 2004. Biological Assessment of Incidental Impacts on Winter Steelhead Listed Under the Endangered Species Act in Non-Indian Mainstem Columbia River Fisheries. February 13, 2004. 38 pp.

LeFleur, C., and C. Melcher. 2004. Addendum to the Wild Winter Steelhead Biological Assessment - Response to NOAA Fisheries Request for Additional Information. November 2, 2004. 42 pp.

Lohn, D.R. and R. McInnis. 2004. Letter to D.K. Hansen, Chairman, Pacific Fisheries Management Council. March 5, 2004. 8 p. w/enclosure.

McElhany, P., M. Ruckelsoaus, M.J. Ford, T. Wainwright, and E. Bjorkstedt. Draft - Viable salmonid populations and the recovery of evolutionarily significant units. NMFS. December 13, 1999. 161 p.

Myers, J., C. Busack, D. Rawding, A. Marshall. 2002. Identifying historical populations of Chinook and chum salmon and steelhead within the Lower Columbia River and Upper Willamette River Evolutionarily significant Units. Co-manager Review Draft. May 10, 2002. 70 p. w/appendices.

NMFS (National Marine Fisheries Service). 1999. The Habitat Approach. Implementation of Section 7 of the Endangered Species Act for Actions Affecting the Habitat of Pacific Anadromous Salmonids. Northwest Region, Habitat Conservation and Protected Resources Divisions, Portland, Oregon (August 26, 1999). http://www.nwr.noaa.gov/1habcon/habweb/habguide/habitatapproach_081999.pdf

NMFS. 2000. Endangered Species Act section 7 Biological Opinion on the reinitiation of consultation on operation of the federal Columbia River Power System, including juvenile fish transportation programs, and 19 Bureau of Reclamations projects in the Columbia Basin. December 2000.

NMFS (National Marine Fisheries Service). 2001. Impacts of the Interim Management Agreement for Upriver Spring Chinook, Summer Chinook, and Sockeye on Salmon and Steelhead Listed Under the Endangered Species Act. March 21, 2001. 97p.

NMFS 2003. Supplemental Biological Opinion to the 2001 U.S. v Oregon "Interim Management Agreement for Upriver Spring Chinook, Summer Chinook, and Sockeye Salmon and Steelhead Listed Under the Endangered Species Act," Covering Winter, Spring, and Summer Season Treaty Indian and Non-Indian Columbia Rivwer Basin Fisheries for 2003-2005. 23p.

NMFS. 2000. Endangered Species Act section 7 Biological Opinion. Consultation on Remand for Operation of the Columbia River Power System and 19 Bureau of Reclamation Projects in the Columbia Basin. November 30, 2004.

NWPPC (Northwest Power Planning Council). 1992. Information on water quality and quantity contained in the salmon and steelhead subbasin plans (above Bonneville Dam) (Document 93-8). September 17.

ODFW/WDFW. 1998. Status Report: Columbia River fish runs and fisheries, 1938-1997. Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife. June 1998.

ODFW and WDFW. 1999. Status report, Columbia River fish runs and fisheries, 1938-1998. Oregon Dept. of Fish and Wildlife, Clackamas, Oregon. 303 p.

OWRD (Oregon Water Resources Department). 1993. Memorandum re: weak stocks and water supply conflicts, to D. Moscowitz et al. from T. Kline and B. Fuji, OWRD, Salem. September 17.

Parkhurst, Z.E., F.G. Bryant, and R.S. Nielson. 1950. Survey of the Columbia River and its tributaries. Part 3. Special Scientific Report - Fisheries, No. 36. 103 p.

Quigley, T. M., and S. J. Arbelbide, editors. 1997. An assessment of ecosystem components in the interior Columbia River basin and portions of the Klamath and Great basins. Volume 3 *in* T. M. Quigley, editor. The interior Columbia basin ecosystem management project: scientific assessment, 4 volumes. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-405, Portland, Oregon.

Ricker, W.E. 1972. Hereditary and environmental factors affecting certain salmonid populations. *In* R.C. Simon and P.A. Larkin (eds.), The stock concept in Pacific salmon. MacMillan Lectures in Fisheries. Univ. British Columbia; Vancouver, B.C.

Roby, D. D., D. P. Craig, K. Collis, and S. L. Adamany. 1998. Avian predation on juvenile salmonids in the lower Columbia River. Report to Bonneville Power Administration and U.S. Army Corps of Engineers. Oregon Cooperative Fish and Wildlife Research Unit, Corvallis, and Columbia River Inter-Tribal Fish Commission, Portland, Oregon. September revision.

Speaks, S. 2000. Biological assessment of incidental impacts on salmon species listed under the Endangered Species Act in 2000 Treaty Indian mainstem and tributary fisheries in the Columbia River Basin between January 1 and July 31, 2001.

Stanford, J. A., and J. V. Ward. 1992. Management of aquatic resources in large catchments: recognizing interactions between ecosystem connectivity and environmental disturbance. Pages 91-124 *in* R. J. Naiman, editor. Watershed management: balancing sustainability and environmental change. Springer-Verlag, New York.

Steel, E. A., and M. B. Sheer. 2002. Appendix I: Broad-Scale Habitat Analyses to Estimate Fish Densities for Viability Criteria. In Willamette/Lower Columbia Technical Recovery Team, Interim Report on Viability Criteria for Willamette and Lower Columbia Basin Pacific Salmonids. Northwest Fisheries Science Center, NMFS, Seattle, WA.

TAC (U.S. v. Oregon Technical Advisory Committee). 2003. Steelhead Handle and Mortality Impacts in the 2002 Non-Indian Spring Chinook Tangle Net Fishery. January 22, 2003.

TAC 2004. 2004 Returns and 2005 Forecasts for Important Columbia River Salmon Stocks. December 17, 2004. 1p.

Tweit, B. and G. Norman. 2000. ESA section 7/10 application for the incidental take of listed species in Washington and Oregon mainstem fisheries of the Columbia River January trough July, 2001.

U.S. vs Oregon Parties. 2001. Interim Management Agreement for upriver spring Chinook, summer Chinook, and sockeye. 28 p.

Wallis, J. 1963. An evaluation of the North Santiam River salmon hatcheries. Oregon Fish Commission Research Laboratory, Clackamas, Oregon. 66 p.

Waples, R. S. 1991. Pacific salmon, Oncorhynchus spp., and the definition of "species" under the Endangered Species Act. Marine Fisheries Review 53:11-22.

WDFW and ODFW 2004a. Wild Winter Steelhead Run Timing. February 27, 2004. 7p.

WDFW and ODFW 2004b. Wild Winter Steelhead Run Timing Additional analysis. March 4, 2004. 4p.